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The Politics and Policies of Higher Education in Texas, 1995-2013

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The Politics and Policies of Higher Education in Texas, 1995-2013

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Dedication

I dedicate this dissertation to my wife, Jeanne, and my children, Bella and Marcos. Your love and encouragement made my return to graduate school and this dissertation possible.

The Politics and Policies of Higher Education in Texas, 1995-2013

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This dissertation is composed of three independent investigations within the subject of higher education policy. Chapter 1 introduces the investigations and provides a description of the authors personal involvement in the policies analyzed. Chapter 2 presents the first investigation, a case study of higher education finance policymaking in Texas from 1995 to 2013. This study used the Advocacy Coalitions Framework and the cognitive linguistic theory of moral politics to identify three advocacy coalitions that competed with each other to affect higher education finance policy. Using a mixed-methods approach, this study identified the policy belief systems of the Egalitarian Coalition, the Free-Market Coalition, and the University Coalition. Through a history of policy changes, this study analyzed the effect of state government moving from bipartisan to one-party Republican leadership. The next two chapters then evaluated two major policy changes that occurred during this policy history. Chapter 3 presents a regression discontinuity analysis that estimated the causal relationship between a state grant program for low-income students and a series of educational and workforce outcomes that define a student's journey through college, the early years of their adult work life, and graduate degree attainment. This study found that grant aid improved persistence and bachelor's degree completion, reduced student debt, and increased the likelihood of graduate degree attainment. Grant effects on early career earnings were positive, but not statistically significant. Chapter 4 presents a

study of dual credit as a school-district policy. This investigation estimated the effects of dual credit on outcomes that trace a student's journey from high school to undergraduate and graduate degree completion. Dual credit was a school district policy that allowed high school students to enroll in college-level coursework and simultaneously earn high school and college credit. This study also investigated the potential for improving the design of dual-credit programs by exploring heterogeneous effects by program attributes. Using panel data with school district fixed effects, this investigation found that increases in the share of students earning dual credit were associated with increased high school graduation; increased university application, admission, and enrollment; shortened time to degree completion; and increased associate, bachelor's, and graduate degree attainment. Chapter 5 concludes this dissertation with a discussion of the policy implications of the findings.

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Chapter 1

Introduction

This dissertation represents the capstone of my graduate studies. It also draws on my fifteen years of public service as a member of the Texas House of Representatives, representing a central city district within the City of San Antonio. My studies at the LBJ School have been a luxury and at times a burden for this forty-something adult with family responsibilities and a full-time job. For the most part, however, the Ph.D. program has been a precious opportunity to slow down, sharpen old skills and gain new ones, and most importantly reflect on my work in politics and public policy.

As a Democrat, I spent all but one session of my legislative career as a member of the minority party. Unfortunately, the session Democrats were in the majority was during my freshman session. It turns out that it's never a good time to be a freshman. But, these experiences taught me valuable lessons in how to be effective when you are at the bottom of a power structure.

During my tenure, my Republican colleagues advanced an ambitious agenda to change the state's approach to higher education finance. Recognizing I could not change their major policy goals, I did my best to plant good seeds within bills that challenged my core values. I was most effective at doing this because I tried to specialize (with great help from my staff) on the subjects I cared most about. I also dedicated significant time cultivating relationships with my elected colleagues and other stakeholders committed to solving the same public challenges in education, though from different perspectives.

My proudest moments occurred when I won policy victories, no matter their size, by being principled and strategic. One example of this took place during the legislative session of 2009. In the previous three sessions, representatives of the University of Texas

at Austin (UT) came to the capitol with a request to eliminate or dramatically cut back the "Top 10 Rule," a state law that granted automatic college admission to students who graduated in the top 10 percent of their graduating high school class. This policy was created as a race-neutral way of providing academically accomplished high school graduates an equal chance at gaining entrance into our state's most selective colleges. They failed to amend this law in each of the three prior sessions. But 2009 was shaping up to be a different session for many reasons.

In 2009, UT once again led the charge to amend the Top 10 Rule. As the university in Texas receiving the most applications, they were most affected by the Top 10 Rule. Within a few years, the policy would have produced the unintended effect of requiring UT to expand their freshman class. During this session, they built significant support with Republicans and succeeded in passing a bill out of the Senate (SB175-81)[1] that would have capped the effect of the Top 10 Rule by having it apply only to 60 percent of a university's entering class. Though the bill arrived in the House late in the session, it appeared that 2009 would be the session they amended the law.

One of the reasons why 2009 was a unique year was that Democrats had won another three seats in the Texas House, putting us on the verge of having equal representation with Republicans, 74 to 76. We used our new-found political strength to replace the sitting Speaker of the House with a Republican House member whom we considered more bipartisan.

I supported keeping the Top 10 Rule unchanged. However, I recognized that the case for amending the law was becoming increasingly compelling and that 2009 might be the best opportunity to negotiate changes from a position of strength. Though Democrats

[1] This study identifies Texas state legislation with the bill number, followed by a dash, and ending with the year of the legislative session.

were not united, I stepped forward and represented a part of my caucus in renegotiating the law with UT's president, Bill Powers, UT's chancellor, Francisco Cigarroa, and Representative Dan Branch, R-Dallas. In the end, we brokered an agreement to raise the cap in the Senate bill to 75 percent and included stronger reporting and oversight over UT's commitment to improve student diversity. An important part of our deal was a handshake agreement that UT would not return to the capitol in the near future to renegotiate the deal. In the end, the four of us were able to sell the agreement to our different constituencies. SB175 became law and remains the law today.

Had I and other Democrats decided to not negotiate, I believe fewer students from historically underrepresented communities would have been granted admission to their dream school as soon after this session Democrats significant representation in the House of Representatives. Also gained from this experience were trust and goodwill, making the next round of debates and negotiations more productive.

This history of policymaking brought me to this study. My concern for our state, its's institutions of higher education, their mission to serve and transform our people and communities, and my concern for helping disadvantaged students influenced the subjects selected for study. Most of all, my commitment to the idea that rigorous analysis and informed debate can and must advance our public policies helped me complete this multi-year study. Finally, in writing this dissertation, my hope was that current and future policymakers would learn from this work and build on our past successes and challenges.

In Chapter 1, I attempted to uncover the history of higher education finance policymaking from 1995 to 2013 with a focus on the ideas and beliefs of this period, rather than focusing on individuals. To accomplish this, I used the Advocacy Coalition Framework (ACF) as an analytic lens to bring to the foreground the policy beliefs and deep core values that organized policy actors into like-minded coalitions and motivated their

actions. This was the first case study of state higher education policy that reviewed nearly two decades of data to surface deeper insights into the policy beliefs and strategic behavior of advocacy coalitions. My motivation for better understanding these coalitions was to help future policy actors of higher education policy navigate their differences and have more productive policy debates.

In Chapter 3, I took advantage of a natural experiment to estimate the impact of TEXAS Grants, a state-funded need- and merit-based student grant program. Using a regression discontinuity research design, this study represented the first rigorous evaluation of grant aid in the country's second-largest state, which educates 10 percent of the nation's children. Texas's size and diversity provided a population that allowed for the estimation of more precise and externally valid results.

Student outcomes investigated included employment rates and earnings while in college, persistence rates, university course enrollment, and bachelor's degree completion. It also examined how state-funded grant aid supplants other types of financial aid awarded and its effect long-term outcomes. The long-term effects of TEXAS Grants analyzed included estimating effects on employment rates, annual earnings, and graduate degree completion up to 10 years post college entry. Overall, the findings expanded our understanding of the benefits to low-income students and the state produced by grant aid programs like TEXAS Grants.

In Chapter 4, I used panel data at the school-district level to perform a school-district fixed effects regression analysis relating changes in dual-credit participation to corresponding changes in secondary and postsecondary student outcomes. This study contributed to the existing literature on the impact of dual credit by using a school district-level analysis that emphasized the effects of dual credit *as a school-district policy*. Previous studies individually compared students who enrolled in dual credit to those who did not.

But, a student's choice to enroll in dual credit was potentially endogenous and may have produced biased effects if, say, students who already had clear college plans were more likely to be enrolled in dual credit.

This dual-credit impact study broke new ground by following students up to 13 years from when they first entered high school to estimate dual-credit effects on educational attainment from high school to graduate degree completion. This study also explored whether dual-credit effects varied between different dual-credit course subjects. For a limited set of shorter-term outcomes, the study also investigated whether instructors with a doctoral degree produced a different impact from those with a master's degree; whether impacts varied by instruction mode; and whether dual-credit courses located on a high school campus produced a different impact than those located on university or community college campuses. Finally, this study explored dosage effects of dual credit to determine whether effect sizes plateaued or declined at higher levels of participation.

The findings of this study highlighted dual credit as a systemic innovation that integrates our historically fragmented education system and has the effect of boosting postsecondary degree attainment.

In Chapter 5, this dissertation concludes with a discussion of the implications of the three independent studies. It also offers policy recommendations to expand the benefits of TEXAS Grants and dual credit.

Chapter 2

Texas Higher Education Finance during Periods of Bipartisan and Republican Leadership, 1995 to 2013

In 2003, the Republican Party assumed complete control of the state government of Texas. Having been in the minority as a political party since Reconstruction, Republicans set out to make their mark on state government including its funding of higher education. During the eight years before 2003, Republicans and Democrats shared control of state government and produced a record of bipartisan legislation in higher education finance, primarily led by Democrats. This study examined the history of higher education finance policymaking eight years before and eleven years after the shift to one-party Republican leadership. It analyzed this policy history using the analytic lens of the Advocacy Coalition Framework (ACF) and a combination of quantitative and qualitative methods. Its research questions were the following: (1) What were the deep core beliefs and policy beliefs that motivated policy actors to advocate for policy changes in higher education finance in Texas from 1995 to 2013? (2) How did change from bipartisan leadership to one-party Republican leadership affect the policymaking process?

Using a descriptive statistical analysis of proposed and passed legislation and a qualitative analysis of public documents, this study found evidence of three distinct advocacy coalitions: the Egalitarian Coalition, the Free-Market Coalition, and the University Coalition. Their names were meant to reflect their deep core beliefs.

The history of these coalitions affirmed existing theories of political and policy decision-making. In summary, the governing coalition in control sets the policy agenda, selects the policy options, and controls what becomes law. Minority coalitions can affect policy change, but they are confined to the domain of policy preferences shared with the

governing coalition. External shocks, such as a change in the elected majority or an economic recession, can affect policy change, but only if exploited by skilled leadership. A dominant coalition will affect policy change within every decision-making venue where it can. A minority coalition can function as a dominant coalition if it is in a position to act as a veto player (Tsebelis, 2000)[2].

THEORY

I used two theories to frame and ground my analysis: the Advocacy Coalition Framework (ACF) first developed by Sabatier and Jenkins-Smith (1988) and the cognitive linguistic theory of liberal and conservative moral politics (Moral Politics) developed by Lakoff (2002). I selected the ACF because it explains complex policymaking processes that involve multiple policy actors from different levels and branches of government. It also emphasized the beliefs and values held by policy actors in explaining policy change, a central concern of this study. I selected Lakoff's Moral Politics to ground my interpretation of higher education policies in an existing body of research on policy preferences and to link party affiliations to liberal and conservative worldviews.

The following subsections define the key concepts of each theory used in this paper.

Advocacy Coalition Framework

Advocacy Coalition

ACF defines an advocacy coalition as an informal network of policy actors, united by a common policy belief system, which advocates for its policy beliefs over an extended period. These policy actors can include elected and appointed government officials, policy

[2] A veto player, as defined by Tsebelis (2000), is a policy actor or group of actors that maybe in the minority but are strategically located within a decision-making process to stop the adoption of a policy change to protect the status-quo that they prefer. An example maybe a group of four legislators on a committee of seven that has undisputed jurisdiction over all policy changes of a given subject in question.

researchers and analysts, political consultants and donors, and anyone else attempting to affect policy in a given policy subsystem over time.

The pursuit of common policy goals forms trust between policy actors, which leads to the formation of advocacy coalitions. By joining an advocacy coalition, policy actors lower their costs of advocacy. Joining occurs by sharing information or coordinating their activities to a minimal but nontrivial degree. Coalitions also form out of a sense of fear or paranoia that other actors with opposing beliefs are working together to affect policy first. ACF refers to this phenomena as devil shift. Devil shift exaggerates the perceived threat of an opposing coalition, overestimating an opposing coalition's plotting and resources.

Policy Subsystem

ACF holds that "policymaking in modern societies is so complex, both substantively and legally, that participants must specialize if they are to have any hope of being influential. This specialization occurs within policy subsystems composed of participants who regularly seek to influence policy within a policy subsystem" (Sabatier & Weible, 2007, p.192). A policy subsystem is typically defined by a policy and territorial dimension. In this study, the policy subsystem is higher education finance in Texas.

Policy Belief System

The ACF holds that a policy belief system of an advocacy coalition is an aggregated distribution of the beliefs held by its members. It consists of three layers of beliefs. First, there are deep core beliefs, which consist of normative and ontological beliefs. Deep core beliefs apply to a coalition's view of the entire system of government. They are the hardest, if not impossible, to change.

Policy beliefs make up the second layer of a belief system. Policy beliefs are an application of deep core beliefs onto the policy decisions of a policy subsystem. Policy

beliefs are also difficult to change but may evolve over a decade or more. Policy beliefs are more unbending the more they are about the norms of government, society, or human behavior. Actors within a coalition will show substantial consensus on issues about their policy beliefs. When policy core beliefs are in dispute, the lineup of allies and opponents tends to be rather stable over time.

Secondary beliefs comprise the third and final layer of a belief system. An actor or coalition will give up their secondary policy beliefs before acknowledging weaknesses in their policy core beliefs. Secondary beliefs can be negotiated. They are typically narrow in scope. They can be rules for implementing a policy. They can also be policy beliefs that are conditionally applied, such as a pilot program that applies a policy change but only in a certain location (Sabatier & Weible, 2007, p.194).

External Shocks

ACF explains policy change with four possible causal pathways. The first involves external shocks. External shocks that occur during this study period involve changes in system-wide governing coalitions, such as the shift from bipartisan state leadership to one-party Republican control. External shocks also include policy changes from other subsystems, such as decisions to cut state taxes. They also include changes in public opinion, and changes in socioeconomic conditions. ACF asserts that external shocks are not sufficient to produce policy change. They must be exploited by skilled leadership (Sabatier and Weible, 2007, p. 191).

Moral Politics

The cognitive linguistic theory of moral politics developed by Lakoff (2002) explains how conservatives and liberals think and talk about what it means to be a good person and to do right in the world. It rests on the finding in cognitive science that human

brains use unconscious conceptual systems, often expressed as metaphors, to frame their thinking and talking. The metaphor of the nation as a family is central to this theory of moral politics (Moral Politics).

In the nation-as-a-family metaphor liberals believe the ideal government is like a nurturing parent that is responsible for caring for its citizens, protecting them against external dangers. Government's principal goal is for its citizens to live fulfilled and happy lives, "deriving meaning from mutual interaction and care" (Lakoff, 2002). When government ensures the needs of its citizens are met–having nutritious food, health care, housing, and education–its citizens will be more productive, responsible, and better equipped to care for themselves, their neighbors, and their community. Consequently, they believe education is a public good. They also believe those who need help should be helped before those who can care for their own needs.

Liberals conceptualize government spending on education as an investment in the development of its citizens into self-nurturing, productive, and socially responsible citizens. Education programs that do not improve these outcomes are failed investments and must be fixed by government action. Finally, a government that fails to take action when its citizens are unable to care for themselves, while others have more than enough, is morally irresponsible.

The Conservative view of government is also rooted in a family metaphor but of a different ideal family. Conservatives believe that the ideal government is like a strict father whose role is to set and enforce rules of behavior so that citizens learn "[s]elf-discipline, self-reliance, and respect for legitimate authority" (Lakoff, 2002). Government's role is not to coddle citizens with social programs, which drain their self-discipline and individual initiative, but to ensure that a ladder of opportunity exists and that everyone has access to it. With a ladder of opportunity in place–an adequate education, a right to work, freedom

from crime–citizens can improve their own lives. And, anyone who fails to climb the ladder of opportunity only has themselves to blame.

Market principles, such as individual choice, limited government, and property rights, hold a powerful place in the beliefs of conservatives. They consider market outcomes to be virtuous because they are the product of individual choice and enterprise. They believe markets are more efficient and productive than government. They also believe an expanding government stifles markets and individual self-reliance, which means fewer jobs and less economic growth.

LITERATURE REVIEW

Seven studies were found in peer-reviewed journals plus another two in published dissertations that used the ACF to identify advocacy coalitions and explain changes in state higher education finance in the US[3]. This section reviews their relevant findings.

State governments found higher education spending to be an easy target in times of revenue shortfalls. Legislators recognized that institutions of higher education have alternative funding mechanisms to mitigate state budget cuts: grants, private endowments, student tuition and fees, and, in some cases like Texas community colleges, taxing authority. Also, higher education spending, unlike public primary and secondary education in many states including Texas, was not a constitutional state requirement. It also lacked federal matching requirements such as those tied to federal Medicaid funds. Consequently, in a competition for state general revenue dollars, primary and secondary public education and health spending tended to crowd out higher education spending (Harnisch, 2016).

[3] I used the online search engine at the library system at University of Texas at Austin to search the libraries at the university. I also performed a search of the PAIS and used the Google Scholar search engine. I searched for articles published in peer-reviewed journals and dissertations that included the terms university, college, or higher education and advocacy coalition framework. I did not limit my search to a date range but did limit it to articles analyzing state policy in the US.

Existing research also suggested that other budget priorities have stronger political constituencies (Harnisch, 2016). In Texas, this was debatable. The University of Texas at Austin and Texas A&M University had large networks of alumni, many of them were leaders in business and politics. As shown in the Policy History section, these groups effectively advocated on behalf of their alma maters.

Existing research that analyzed higher education in Texas during the time period of this study identified two advocacy coalitions. One case study that primarily relied on interviews identified and named one coalition the Egalitarian coalition, a name this study carried forward. In 2001, the Egalitarian coalition helped pass a state law allowing undocumented immigrants residing in Texas to pay in-state resident tuition (ISRT). This coalition was found to consider access to higher education a social justice, equal rights issue. Its members primarily included Hispanic and African-American Democratic legislators and civil rights organizations, including the Mexican American Legal Defense and Education Fund (MALDEF), League of United Latin American Citizens (LULAC), National Council of La Raza (NCLR), and the National Association for the Advancement of Colored People (NAACP). It also included Hispanic Chambers of Commerce (Dougherty, Nienhusser, & Vega, 2010).

The Egalitarian coalition was successful in Texas because it found common ground with a business-led advocacy coalition, unnamed in the existing literature. The Egalitarian coalition did this by framing ISRT for undocumented residents in terms of workforce development and economic objectives, describing the policy change as in the state's economic self-interest.

The Texas business-led advocacy coalition included business associations, Governor Rick Perry, and most Republican legislators in the 2001 legislature. It viewed higher education as a strategy for economic development and a means for growing a

competitive labor market. In an interview regarding ISRT for undocumented residents, a Texas business leader said, "[Business organizations] are pretty pragmatic…[M]ost business organizations, at least the ones I know, are not going to split hairs on the pedigree of that person. Educate them if they're here." (Dougherty, Nienhusser, & Vega, 2010)

The existing literature suggested that business-led policy coalitions advanced policy agendas with a common set of proposals. These included performance-based funding; cost-containment facilities management techniques; online courses; strategies that efficiently integrate secondary to postsecondary education such as dual credit[4] or Advanced Placement (AP) programs; career pathways that favor technical skills over liberal arts; commercialization of university research; and incentives for timely degree completion. Business-led coalitions were found to provide skilled leadership that was successful at changing the allocation of existing higher education funds rather than growing state spending on higher education (Harnisch, 2006; Dougherty, Nienhusser, & Vega, 2010; Dougherty, et al., 2013; Protopsaltis, 2008).

There was a final set of policy actors that appeared in the literature but were not developed as an advocacy coalition—university and community college administrators. These actors were treated as policy brokers, arbitrators who mediate conflict between competing coalitions and seek stability for the policy subsystem. The existing literature did not identify their policy beliefs. It also did not consider their role as policy brokers as a strategy for advancing a policy agenda (Shakespeare, 2008). The policy broker concept was an area of the ACF that theoreticians recognized as underdeveloped (Weible, Sabatier, & McQueen, 2009).

[4] Dual credit programs allowed high school students to enroll in college-level coursework and simultaneously earn high school and college credit.

However, behaviors of higher education administrators have been documented. Higher education administrators opposed policies that threaten their funding or their administrative discretion. They viewed performance-based funding with skepticism, believing it was intended to rationalize budget cuts. When they did support performance-based funding, they did so reluctantly and with the hope that their cooperation would improve their chance of greater funding or autonomy (Dougherty et al., 2013; Protopsaltis, 2008).

Of the states studied, a change in the political control of the legislature coupled with skilled policy leadership increased the likelihood of policy changes. For example, the adoption of performance-based funding followed a change in political party leadership in Colorado, Missouri, Florida, South Carolina, Illinois, Washington, Michigan, and Virginia. While coalitions can cross party lines, a switch to Republican control typically strengthened the business-led coalition relative to others. When this occurred advocates of performance-based funding were successful (Dougherty et al., 2013; Harnisch, 2016; Protopsaltis 2008).

Contribution to Existing Literature

This study has contributed to the existing literature by studying one policy subsystem over an extended period of time, using a mixed-methods approach, and answering new research questions. It was the first study of state higher education policy that reviewed 19 years of legislation, allowing it to follow a subsystem across changing political leadership and other external factors to describe in greater detail policy belief systems. Finally, it focused on the transition from bipartisan to one-party Republican leadership, allowing it to portend the future of policy change in other states that experience a similar shift in leadership.

RESEARCH DESIGN

I designed this study to be a theory-based case study with qualitative and quantitative methods. I started with defining my research questions and identifying relevant theoretical propositions. I then determined the selection of the Texas higher education policy subsystem as the unit of analysis to be followed over a period that spanned bipartisan and one-party Republican leadership, 1995 to 2013. (Yin, 2014).

I made state legislation the primary data for uncovering policy beliefs. And I used a review of state government reports, news reports, and public statements by key policy actors to validate my findings and enrich them. My validation process also involved analyzing the history of policy, integrating the coalitions identified with their actions across the study period.

METHODOLOGY

An advocacy coalition is a theoretical construct. It is not seen but inferred. As such, I inferred membership in a given coalition based on a legislator's party affiliation. Though advocacy coalitions are not political parties, when political parties are highly polarized along a liberal-conservative spectrum, as they are in Texas (Jones, 2013), theories about the policy and deep core beliefs of liberals and conservatives can be leveraged to interpret the beliefs of Democratic and Republican legislators.

But were political parties highly polarized in Texas during the period studied? I tested this assumption by analyzing an ideological score of each legislator in each legislation during the study period. The ideological score reflected the legislator's degree of liberalism or conservatism along a spectrum of liberal to conservative ideology. These scores were derived from their voting records during the study period (Jones, 2013).

I used a truncated regression analysis[5] to model the relationship between party affiliation and liberal (or conservative) ideology. As described by Equation A1, the expected liberal-conservative score of legislator *i* at time *t* ($Libcon\_score_{it}$) was modeled as

$$Libcon\_score_{it} = \alpha + \beta_1 Democrat_{it} + Session_t + \varepsilon_{it}, \qquad (A1)$$

where $Democrat_{it}$ was a dummy variable indicating Democratic affiliation of legislator *i* at time *t*, β_1 represented the Democratic effect, $Session_t$ represented the time fixed effects, α represented a constant term, and ε_{it} represented the error term. As shown in Table A1, party affiliation as a Democrat moved a legislator's liberal-conservative score from .61 to -.59, a swing of -1.2 points. Party affiliation was a statistically significant and meaningful predictor of ideology.

Having confirmed political parties were highly polarized, I leveraged the theories of Moral Politics (Lakoff, 2002) to interpret and analyze the policy preferences of two advocacy coalitions: one liberal and one conservative. I began this process by using Moral Politics to draw profiles of the policy belief systems of a liberal and conservative advocacy coalition within a higher education finance subsystem.

I then used a data set of higher education finance legislation to identify policy preferences for liberal and conservative members of the Texas legislature. I did this by calculating the probability of liberals and conservatives filing a given topic of higher education finance, respectively.

I then integrated the policy preference measures into the profiles of the two policy belief systems. I then validated and enriched this analysis with insights from supplementary

[5] Truncated regression analysis was used because the data analyzed ranged from negative one to positive one.

documents (committee reports, news reports, State of the State addresses, and other public documents).

I identified a third coalition using a purely qualitative approach. I assumed higher education public administrators are policy brokers who belong to an advocacy coalition. I then tested this assumption based on a review of the supplementary documents. I could not use an analysis of legislation to identify the policy preferences of university and community college administrators because Texas prohibits state employees from giving testimony in committee for or against legislation. However, state law did not limit these administrators from stating their general policy preferences outside the legislature. Nor did it restrict the actions of their supporters. These statements and actions as reported in public documents allowed me to build a profile of this third coalition's policy belief system.

Study Limitations

This case study was limited by its small sample size. Although this case study produced significant internal validity with deep insights into higher education policymaking in Texas, analysts must take care in directly applying the findings to other cases or settings.

This analysis was also vulnerable to my biases as the researcher and someone who participated in the policymaking processes studied. I served as an elected Democratic member of the Texas House of Representatives from 2000 to 2015. I served on the education appropriations committee, participated in many of the higher education debates, and authored numerous higher education bills. This experience gave me unique first-person insights, including a deep understanding of the workings of the legislature, the issues of the time, and the advocacy groups engaged in higher education finance. However, it also increased the likelihood of bias, specifically confirmation bias. To mitigate this threat, I

reflected on my potential biases and preconceived notions before and during the study to prevent them from distorting the analysis.

DATA

I collected data on the Texas higher education finance subsystem from five types of public documents from 1995 to 2013: legislation, government agency reports, news articles, state of the state addresses by the governor, and public documents referred to in news articles (such as public letters, speeches, press releases, and web content).

I identified and downloaded bills proposed during the legislative sessions within the study period using the online search engine of the Texas Legislative Council. I used the following classifications to find relevant bills: Education-Higher-Finance; Education-Higher-Student Fees; Education-Higher-Student Financial Aid; and Education-Higher-Tuition.

I then read through each of the 2,380 bills downloaded to ensure the final dataset was limited to the following higher education finance subjects: student tuition or fees, institutional funding, facilities funding, student financial aid, higher education cost control measures, and college savings programs. This filtering process resulted in a population of 1,373 bills. Bills that addressed financial processes (such as accounting methods, payment or refund methods), studies, or notifications were excluded.

The librarians of the Texas Legislative Reference Library helped me locate relevant state government agency reports, the Governor's State of the State Addresses, and news articles. We found 14 reports dealing with some aspect of higher education finance. Using LexisNexis, we also found 223 printed news articles dealing with tuition deregulation, TEXAS Grants, and dual-credit policies from Texas newspapers, *Texas Monthly*, and the

Texas Tribune. I chose these topics because they produced conflict and compromise across different groups and challenged different deep core beliefs.

I analyzed the content of the legislation in a multistep process. I first read the legislation, developed a set of codes that characterizes the proposed policy solutions, and then coded each bill on a second and third reading with the following labels: Democratic primary author, Republican primary author, tax-credit-financed student aid, privatization, college cost containment, research funding, technical education, tuition deregulation, tuition regulation, student fee increase, college credit transferability, institutional funding, tuition or fee exemption, student loan program, facilities funding, TEXAS Grants, student financial aid, merit-based student financial aid, need-based student financial aid, dual credit, pre-paid savings program, in-state resident tuition (ISRT) for undocumented residents, removal of ISRT for undocumented residents, and affirmative action. I derived these labels from a manifest analysis of the bills. Bills coded with a given topic promoted the topic unless specified otherwise.

Due to resource limitations, I was the only reader involved in the coding process. I used a computer-assisted coding system named MAXQDA. It allowed me to store all documents, record my coding system, and apply a uniform set of codes. Future research should enlist other readers to ensure the replicability of the coding process.

MAXQDA also allowed me to produce a data table that described each higher education finance bill with a complete set of variables reflecting the codes. This allowed me to perform the statistical descriptive analysis of legislation.

POLICY BELIEF SYSTEMS

Three advocacy coalitions competed to advance their policy and deep core beliefs on higher education finance in Texas from 1995 to 2013. This study named them the Egalitarian Coalition, the Free-Market Coalition, and the University Coalition.

The Egalitarian Coalition

The Egalitarian Coalition was an advocacy coalition that included liberal legislators. The liberal-conservative score of legislators of the Egalitarian Coalition ranged from an average per session of -.41 to -.69.

The Egalitarian Coalition's legislative members reflected the racial and ethnic composition of the state. Of these legislators, 40 percent were Hispanic, 15 percent were African American, and the remaining 45 percent were White. Hispanic and African-American legislators were the most prolific authors of higher education finance legislation in the Egalitarian Coalition. Hispanic and African-American legislators filed 48 and 25 percent of the Egalitarian Coalition's legislation, respectively.

Other members of the Egalitarian Coalition included the civil rights organizations identified in the literature review, labor unions, and advocates at the Center for Public Policy Priorities.

The Egalitarian coalition viewed higher education as a public resource that government, led by democratically elected officials, had a responsibility to deliver. They believed higher education was a means for social and economic mobility and equality. By earning a college education, they believed people would improve their ability to take care of themselves and others in their community. They also believed limited resources should be prioritized to help those with the greatest need.

The legislation they filed supported this characterization. As shown in Figure A1, legislators of the Egalitarian Coalition authored 100 percent of the legislation promoting

affirmative action policies intended to close the gap in college enrollment between minority and White students. They authored legislation providing ISRT to undocumented Texas residents. They also authored a disproportionate share of bills that provided need-based financial aid, regulated tuition, exempted some students from paying tuition and fees, promoted dual-credit and college credit transfer policies, all types of student financial aid including merit aid and loans, and raised tax dollars dedicated to higher education.

Policy narratives illustrate policy beliefs (McBeth, Shanahan, & Jones 2004). The basic story the Egalitarian Coalition told about policies they supported cast government action as the hero, a system (either a set of laws or market forces) that fails to help students who need help as the villain, and students as victims. Collateral victims were the families who struggled to send their children to college and a larger society that lost the potential of its less educated. The moral of their story was that government action through public policies like tuition regulation, TEXAS Grants, or dual credit helped students who would otherwise not be able to gain access to college, and by helping these students, the individual and larger society benefited. The following quotes were examples of this basic narrative:

> In anticipation of the passage of TEXAS Grants, Rep. Irma Rangel said: "I hope that (new scholarships) will increase access to education to many more students…Educate (all the students), because otherwise we will all be responsible for a great disaster upon our economy (Falkenberg, 1999)."
>
> Rep. Garnet Coleman in his opposition to tuition deregulation said: "It's a tax on the middle-income families. The way we are getting new revenue is through people who are trying to better themselves (Flores & Stone, 2003)."
>
> Rep. Veronica Gonzales, a legislator from the Rio Grande Valley, on the effects of a roll back of dual credit said, "If that happens we are going to have a lot of doors closing on a lot of students. It would be especially bad for our area because so many of our students cannot afford to take these classes at full credit and pay the full amount (Bertron & Taylor, 2011)."

The Free-Market Coalition

The Free-Market Coalition was an advocacy coalition that included conservative legislators. The liberal-conservative score of legislators of the Free-Market Coalition ranged from an average per session of .50 to .62.

The ethnic and racial composition of the Free-Market Coalition did not reflect the demographics of Texas. Of these legislators, 4 percent were Hispanic, 1 percent were African American, 1 percent were Asian, and the remaining 94 percent were White. White legislators authored 96 percent of its legislation related to higher education finance.

Other policy actors of the Free-Market Coalition included individual businessmen, the Texas Association of Business, and the Texas Public Policy Foundation.

The Free-Market Coalition viewed government spending on higher education as a necessary evil for producing skilled workers and entrepreneurs and creating innovations through research, primarily in fields of science, technology, engineering, and medicine, that could be commercialized. They assessed the value of higher education like a business, giving special attention to performance measures such as total degree production, cost per degree produced, average earnings per degree program, and research dollars generated per researcher. The legislation they filed reflects this characterization.

As shown in Figure A1, conservative legislators of the Free-Market Coalition authored all legislation promoting performance-based funding policies intended to increase degree production, research dollars generated, and reward cost containment. They also authored all legislation related to privatizing aspects of higher education finance and providing tax reductions to business that donate to college scholarship funds. The Free-Market Coalition authored a disproportionate share of bills that eliminated student financial aid for undocumented Texas residents, contained college costs, deregulated tuition by moving tuition-setting authority closer to the universities, used tuition rebates to

incentivize timely degree completion, and promoted research and technical education. They opposed Egalitarian proposals to increase government spending on higher education through increased taxes (SJR9-80; SB2527-81).

In-state resident tuition (ISRT) for undocumented residents represented a controversial issue for the Free-Market Coalition. In the first half of the study period, it supported ISRT for undocumented residents because they believed it was good for business. However, in the second half of the study period, a subgroup of its legislators that viewed immigration as a threat and cost to society grew in size. Its mixed record on bills related to immigration reflected an internal conflict for the Free-Market Coalition.

The basic story the Free-Market Coalition told about policies they authored cast college administrators and faculty as villains who were overpaid and lazy, students and taxpayers as victims, and free-market solutions as heroes. The moral of their story began with identifying the problem: administrators who were paid high salaries and faculty who taught few classes burdened taxpayers and failed to meet the needs of our economy. Free-market principles could discipline these wasteful government employees, so they become productive and cost-efficient; thereby reducing the burden to taxpayers, helping more students access and complete college, and growing our economy. The following quotes were examples of this narrative.

> In its final report, a state commission, formed and led by members of the Free-Market Coalition, stated: "[The Commission] recommends a redesign of the funding of higher education combined with a reduction of bureaucratic controls. Such a redesign would seek to empower parents and their children and improve access to higher education by offering grants to students who meet clearly defined requirements for college preparation. The redesign would also seek to create a system that is more flexible and responsive to the needs of our economy and its citizens… [A] less regulated, freer market orientation will result in better resource allocation decisions than a more regulated market subject to controls by centralized authorities (Special Commission, 2001)."

> Jeff Sandefer, a businessman and member of the Free-Market Coalition, explains his support of higher education finance reform: "It's time for the Texas Legislature to stop writing 'blank checks' to our state colleges and universities for tenured professors to spend as they please…Instead, all state higher education funding should be directed to scholarships, so universities once again will have to answer to the people who pay the bills. That's the only way students, parents, and taxpayers will ever regain control of our universities. (Patel, 2010)"

The University Coalition

The University Coalition was an advocacy coalition that included public administrators of universities and community colleges.[6] The public administrators who led the University Coalition were university and community college presidents, chancellors of higher education systems, and government affairs professionals at colleges and universities. The University Coalition also included policy actors who loosely coordinated their advocacy for policies that increased funding and autonomy for institutions of higher education. These policy actors included alumni, philanthropists, faculty associations, the Texas Association of Community Colleges, and the Association of American Universities.

Alumni and donors represented key members of their coalition. These members provided the University Coalition political resources in the form of money and citizens who would called on their elected representatives. Their alumni and donors ran political action committees with names like "Friends of the University PAC," which donated to the campaigns of elected officials and hired lobbyists and public relations professionals (Texas Ethics Commission, 2017).

The University Coalition believed its institutions of higher education were public institutions with broad public missions to educate and serve society. Like the Free-Market Coalition, they too believed that their institutions were engines of economic activity. Like the Egalitarian Coalition, they too believed that their institutions were instruments for

[6] I shortened the name from the University and Community College Coalition for brevity and because most of the documented conflict during the study period involved public universities.

social justice and advancement. However, they also believed their mission was about the intellectual cultivation of their students and the expansion of human knowledge produced by their faculty. They believed education was an end goal not only a means to an end.

Furthermore, they believed that institutions of higher education were complex enterprises built over time with engaged faculty, students, donors, and alumni. They believed their greatest asset was their faculty and that their greatest challenge was attracting and keeping talented faculty. They believed the work of building a quality institution of higher education occurred with their faculty in classrooms and laboratories. As a result, they believed the loss of administrative autonomy harmed their ability to strengthen their institutions.

The University Coalition supported tuition deregulation because it came with the promise of greater autonomy. They opposed any policy reforms that "micromanaged" how they operate. They opposed performance-based funding that did not take into account their different missions and respective student bodies. Instead, they supported increases in direct funding with broadly defined outcome measures that evaluated each institution relative to its past track record of performance.

The basic story that the University Coalition told about policies they supported cast their faculty and researchers as heroes, policies that underfunded postsecondary education or lessened their administrative discretion as villains, and students and our society as victims. The moral of their story was that with more resources and autonomy their institutions could help more people complete college and advance our society.

The following quotes from the former President of the University of Texas in his 2011 State of the University speech illustrated how the University Coalition viewed their mission and exemplified their policy narrative:

> "[Students] will have a richer life [earning a college education], productively, financially, intellectually, and even spiritually. If enough of them do this, society itself will have a richer collective life. (Powers, 2011)"

> "[By allowing researchers to research topics of their own interest] they will increase our collective understanding of the world and our place in it. This increased understanding establishes a higher platform from which the next generation goes forward. History has clearly shown that societies with a richer understanding of the world – that is, of science – and a richer understanding of the human condition – that is, of the humanities – are more productive and more civilized in the long run. (Powers, 2011)"

> "Our faculty are not the problem. They are our strength. Not only are they not the problem, they are a big part of the solutions to the very real challenges we do face…We simply need to be given the space to [improve graduation rates]. If we aren't, if we are pulled hither and yon from one project to another, we won't be able to accomplish our mission. Put bluntly, tilting at the windmills of supposed faculty who don't work hard or who don't care about our undergraduates – for all the rhetoric about dodgers and coasters – will simply divert us from the real tasks at hand. And it will severely damage our ability to attract and retain our talent. (Powers, 2011)"

The University Coalition was not monolithic. Two substantive issues divided two-year institutions from four-year institutions: dual-credit and college credit transfer policies. Community college administrators were found to make public statements supporting the expansion of dual credit and the creation of a statewide system of college credit transfer, while administrators of four-year institutions were found to make public statements less supportive or opposed to these policies (Austin, 2007; Mellon, 2008; Holloway, 2010).

A second division of the University Coalition separated the well-endowed research universities from the regional universities that had fewer resources and less selective admission standards. This study found regional college advocates perceived tuition deregulation as a solution that served the more highly-selective universities. And they feared that its passage would lead to less state support for regional universities (Meritz, 2003).

POLICY HISTORY

Prologue

After Reconstruction, Texas, like other former Confederate states, was a one-party Democratic state dominated by conservatives. Conservatives advanced their policy beliefs by nominating conservative candidates to run as Democrats in the general election and on occasion voting for Republican presidential candidates considered more conservative, such as in the election of President Eisenhower in 1952 and 1956. Conservatives, ideologically compatible with Republicans, began shifting to the Republican Party in the 1960s after the passage of the Civil Rights Act and once they established their electoral viability. Republicans unified their constituencies with messages of states' rights and local control, low-taxes, pro-business, and family values. Rick Perry was emblematic of a high-profile Texan who came up the ranks as a Democrat, only to join the Republican Party, and eventually lead the state as its longest-serving governor.

The 1980's represented a transition period when Republicans were growing their field organization and Democrats of liberal to moderate leaning controlled their party. In 1982, a slate of Democrats won statewide election. All were re-elected in 1986, except for Governor Mark White. In 1990, Democrats won all statewide elections. The period of state government led by liberal-to-moderate Democrats lasted for 12 years, ending in 1994 when all but one statewide Democratic officeholder lost re-election (Davidson, 1990).

Bipartisanship

Elections

During the legislative cycles of 1995 to 2001, Republican and Democratic state officials shared power. Republicans held the Governor's office, the Comptroller's office, the Office of Attorney General, and a majority in the Senate. Democrats held a majority in

the House of Representatives (the House) and for part of the time held the Lt. Governor's office.

Democrats were outnumbered. However, they held the advantage of the status quo. For the prior 12 years, their Egalitarian Coalition had set in place the policies that defined how and at what levels the state would support higher education. This created a strategic opportunity for the Egalitarian Coalition. Because their liberal members controlled the House, they held veto authority over any proposed changes to existing laws. The Egalitarian Coalition was what Tsebelis (2000) calls a "veto player."

Though there was a genuine spirit at the time for doing "what's right for [Texas]" regardless of party (Sweany, 2013), when Republican candidate George W. Bush defeated incumbent Democratic Governor Ann Richards, he had no experience in elected office and faced a Democratically-controlled state legislature, as shown in Figure A2. Governor Bush's first decision was to make friends with the presiding officers of the legislature, Democratic Lt. Governor Bob Bullock and Democratic Speaker of the House Pete Laney. Lt. Governor Bullock mentored Governor Bush before retiring at the end of Bush's first term (McNeely & Henderson, 2008).

In 1998, the Republican Party elected Rick Perry to what many considered the most powerful elected office in Texas, the Office of the Lt. Governor. The Texas Lt. Governor presided over the Texas Senate and held significant authority over the state's budget and legislative process. However, the newfound legislative authority of conservatives, and their Free-Market Coalition, was tempered by Governor Bush's interest in the US Presidency.

In 1999, Governor Bush formed an exploratory committee and began preparing to run for the presidency as a governor who was "a uniter, not a divider." Fighting with the Democratic-controlled House would have been counterproductive for his state agenda and

national run. During this legislative cycle, the Egalitarian Coalition maintained its role as a veto player in the House (Balz, 1999; Horowitz, 1999; Mitchell, 2000).

The 2000 election cycle proved momentous for national and Texas government. When Governor Bush became the 82nd US President, Rick Perry ascended to the Governor's Office, and for the first time in its history, the Texas Senate elected a member from its ranks to fill the Lieutenant Governor's position. Republican Bill Ratliff became the Lt. Governor with the help of a united block of Democrats and enough independent Republican state senators. Once again, the Egalitarian Coalition maintained its control of the House. These events allowed the Egalitarian Coalition to effectively act as the governing coalition over the higher education finance subsystem. However, there were external events that were outside of its control.

External Factors

Dynamic external factors affected the Texas higher education finance subsystem. On March 18, 1996, a three-judge panel of the Fifth US Circuit Court of Appeals set off a major reaction in higher education policy with the *Hopwood v. Texas* decision. The court opined that any consideration of race by the University of Texas Law School in their admissions process was unconstitutional, discarding the state's desegregation plan negotiated with the federal government. In response to the court, State Attorney General Dan Morales issued a far-reaching opinion prohibiting the use of affirmative action in Texas higher education. These decisions impacted higher education finance and reduced minority student enrollment (Harris & Tienda, 2010; Laycock, 2016).

State Funding

During the bipartisan period, the Egalitarian Coalition determined higher education finance policy. Their formula consisted of stable direct institutional funding to universities

and community colleges, moderate increases to tuition rates that were kept relatively low, and student financial aid to encourage college enrollment of lower-income students.

During the six years of bipartisanship, the state legislature supported public colleges with direct funding based on their enrollment levels and allowed for regular but limited increases in tuition (HB1792-74, HB2531-77). As shown in Figure A3, state institutional funding[7] per full-time student remained relatively level, while tuition rates increased at an annual average of 6 percent each year between 1996 to 2003. In 2003, the last fiscal year budgeted during this period, the state provided universities direct institutional funding of $5,807[8] for each full-time equivalent student enrolled (not including funds for TEXAS Grants or any other student financial aid), while the average Texas resident enrolled full-time paid $3,903 in annual tuition and fees (not including student financial aid).

Community colleges in Texas have locally-elected boards with authority to set tuition rates and levy property taxes, a revenue source public universities lack. As shown in Figure A3, state institutional funding per full-time community college student declined by 10 percent between 1996 and 2003. One explanation for this decline was that budget writers recognized a growth in the property taxing capacity by community college districts. In 2003, the state provided direct funding to community colleges of $2,792 for each full-time student enrolled, while the average in-district full-time community college student paid no less than $1,687 in tuition and fees.

The most notable change in funding during this period was the creation of a new stream of spending dedicated to supporting need-based financial aid. This policy change

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[7] Institutional funding represented state general revenue funding allocated directly to universities to support their operations and maintenance of existing facilities. It did not include student grant aid or facilities funding for new construction.

[8] All dollar figures in this analysis were expressed as 2016 real dollars.

was authored by members of the Egalitarian Coalition. In 2003, the state allocated $193 million dollars for the Towards Excellence and Access Grant program (TEXAS Grants; HB713-76), as shown in Figure A4. TEXAS Grants was the first need-based college scholarship program in Texas intended to reach all eligible public college students[9]. Though primarily allocated based on financial need, this scholarship also included academic eligibility requirements.

Chapter 3 presents an evaluation the TEXAS Grants program.

Substantive Policy Changes

The Egalitarian Coalition controlled the policy agenda of substantive policy[10] changes. As shown in Figure A5, not one topic passed into law that the Egalitarian Coalition was not willing to author. Furthermore, the Egalitarian Coalition passed numerous policies that the Free-Market Coalition was unwilling to author. The Egalitarian Coalition authored and passed ISRT for undocumented residents with support from some members of the Free-Market Coalition. It also authored and passed the creation of TEXAS Grants; the creation of the Texas Tomorrow Fund, a prepaid college tuition savings program that was guaranteed by the state (HB1336-74, HB8-75, HB9-75); the creation of dual credit (HB1336-74; HB3290-76), and the establishment of criteria, largely based on student socioeconomics, that could be used in place of affirmative action (HB1641-77).

Chapter 4 presents an evaluation of Texas' dual-credit policy.

The Egalitarian Coalition also authored and passed legislation that created the "Top 10 Rule." A policy change that required undergraduate programs of public universities to grant automatic admission to students who graduated in the top 10 percent of their

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[9] Previous need-based grant programs were only modestly funded.

[10] Substantive policy was considered policy not dealing with appropriations.

graduation class and applied for admission (HB588-75). This policy change would deliver a pronounced benefit to minority and rural white students (Long, Saenz, and Tienda, 2010).

The Free-Market coalition was not without its legislative victories. It authored and passed five of six proposals to limit the growth of college costs, and two of three proposals to advance technical education. But, its most important legislative achievement involved planning its future.

Planning

Before the end of the 76th legislative session in 2001, Lt. Governor Rick Perry, a leading member of the Free-Market Coalition, established a 17-member commission of state senators and leaders in business and higher education. Lt. Governor Perry charged the commission with the task of addressing the challenges faced by higher education in the 21st Century. Named the Special Commission on 21st Century Colleges and Universities (21st Century Commission), it operated at the same time as a previously launched planning process of the Texas Higher Education Coordinating Board (Coordinating Board), which operationalized its Closing the Gaps by 2015 goal-setting plan.

The 21st Century Commission's report, little noticed at the time, produced a roadmap of policy change for the Free-Market Coalition. It emphasized its concern for efficiencies and productivity in higher education. It laid out its free-market philosophy, stating "[T]he Commission seeks, foremost, to promote the general principle that a less regulated, free-market orientation will result in better resource allocation decisions than a more regulated market subject to controls by centralized authorities." It recommended "[developing] a system of funding that places greater emphasis on state funding of grants to students over direct appropriations to institutions" (Special Commission, 2001). The

21st Century Commission's report represented a major shift in direction and set the course of higher education finance for the period of one-party Republican leadership.

One-Party Republican Leadership

Elections

The 2002 election cycle completed the Republican takeover of Texas state government. Already in control of every statewide office and the State Senate, Republicans gained control of the House by a margin of 92 to 58. Republicans won seats previously unwinnable following a redistricting of legislative districts by the Republican Party. Their victory marked an end to the Egalitarian Coalition's role as a veto player.

The Free-Market Coalition moved forward with its policy agenda. They decreased direct funding of higher education institutions by 30 percent from 2003 to 2015. They allowed for the increase in student tuition and fees by 60 percent over the same period. They mitigated the increase in tuition and fees for lower-income families by setting aside more funds for TEXAS Grants. State general revenue dedicated to TEXAS Grants increased from $193 million in fiscal year 2003 to $368 million in fiscal year 2015, as illustrated in Figure A4. Moreover, the share of eligible students it covered increased from approximately 60 percent of eligible 2004 high school graduates to 83 percent of eligible 2014 high school graduates[11].

External Factors

The Free-Market Coalition exploited several events outside of the legislative process to advance their policy agenda. Texas experienced two downturns in its economy, resulting in a decline in state tax revenue. In 2003, the 78th legislature faced a state general

[11] Coverage rates of TEXAS Grant eligible students were calculated by the author of this study using data from the University of Texas at Austin Education Research Center.

revenue shortfall of $10.2 billion,[12] or a 16.8 percent revenue gap, to maintain level funding in the upcoming budget cycle (Legislative Budget Board, 2004). In 2011, the 82nd legislature faced a state general revenue shortfall of $9.0 billion,[13] or an 11 percent revenue gap, to maintain level funding in the upcoming budget cycle (Legislative Budget Board, 2012). In response to these events, the Free-Market Coalition reduced state spending on higher education.

On November 22, 2005, the State Supreme Court declared Texas's system of public school finance unconstitutional and gave the Legislature until June 1, 2006 to fix it. This caused a rewrite of the tax code to generate new state funds to offset the state's unconstitutional overreliance on local property taxes. As a result, the state's constitutional requirements to fund public education, and the conservative leadership's imperative to not increase state per-capita spending, caused the state to shift the balance of state general revenue away from higher education and to primary and secondary public education (Elliott & Robison, 2005). Total state general revenue for public education increased by 20.3 percent from the two-year budget of 2006-2007 to 2008-2009, while total state general revenue for higher education increased by approximately half that rate, or 10.4 percent, over the same period (Legislative Budget Board, 2008).

Like other states, Texas experienced a growth in health care expenditures due to medical cost increases, an aging population, and increases in Medicaid caseloads. From the first to the last fiscal year budgeted during this period, 2004 to 2015, general revenue allocated for health and human services grew from $9.5 billion to $15.4 billion, an average annual growth rate of 6.8 percent. The growth in health and human services required by federal matching rules reduced the amount of general revenue available to higher

[12] The revenue shortfall in nominal dollars in 2003 equaled $7.8 billion.
[13] The revenue shortfall in nominal dollars in 2011 equaled $8.4 billion.

education. This budget strain was not experienced to the same degree during the period of bipartisan leadership. From 1996 to 2003, state general revenue allocated to health and human services grew by an average annual rate of 1.7 percent.

A final factor external to the Texas higher education policy subsystem was the Republican Party's commitment to reducing the size of government. During the periods of bipartisan and one-party Republican leadership, the Republican deep core value for low taxes and limited government was unchanging. However, its implications on higher education were pronounced in a period of rising costs in public education and health care as described above.

As shown in Figure A7, Texas government spending per capita remained flat during the study period and decreased relative to its growing economy. To keep government spending from rising while public education and health care spending grew, the state government made cuts in other areas and shifted the responsibility of state services to local governments. In higher education, the shift was to local governments and students.

Figure A8 provides a closer examination of state spending. Gross state general revenue dollars (GR) followed a slight general positive slope over time. However, GR relative to the state's population remained relatively flat.

State Funding

By 2005, students, through their tuition and fees paid, replaced the state as the primary funder of university and community college operations, as shown in Figure A3. By 2015, the last fiscal year budgeted in this period, public colleges and universities received roughly twice as much money from students as from state institutional funding. In the last state budget written during this period, the state provided universities direct

funding of $4,179 for each full-time student enrolled, while the average Texas resident enrolled full-time paid $8,285 in annual tuition and fees in 2015.

Tuition and fee revenue rose faster than institutional aid declined. Though state institutional funding per full-time student declined, universities received more funding from the combination of institutional aid and tuition and fee revenue, as indicated by the green line in Figure A3. By 2015, the combined revenue streams equaled $12,465 per full-time student, or $2,755 more than its level in 2003.

Community colleges also experienced a rise in tuition and fees above state institutional funding. By 2015, the state provided community colleges direct funding of $1,952 for each full-time student enrolled, while the average full-time community college student paid $2,703 in annual tuition and fees, as shown in Figure A3. Like public university funding, the combination of institutional aid and tuition and fee revenue increased over time. By 2015, the combined revenue streams equaled $4,655 per full-time student, or $177 more than its level in 2003.

Substantive Policy Changes

The Free-Market Coalition took charge during this partisan period, rewriting major higher education policies over the objections of an often-splintered Egalitarian Coalition. A coordinated effort between the Free-Market Coalition and the University Coalition produced the most significant policy change during this period. Together they passed legislation that shifted the authority to set tuition rates from the state legislature to the board of regents of each system of public universities (HB3015-78). The Free-Market Coalition named this policy "tuition deregulation" because they believed it incorporated free-market principals into higher education policy, much as the 21st Century Commission had

advocated. Though "tuition deregulation" was not an accurate description, it described the policy ideals of the Free-Market Coalition.

When it seemed that the tuition deregulation stalled, the University Coalition dispatched university presidents to meet with legislators and communicate their support for tuition deregulation and to assure members they would not dramatically increase tuition rates (Kay, 2003). They also supported the inclusion of a requirement to set aside a portion of new revenue generated from increased rates to need-based student financial aid. This caused some members of the Egalitarian Coalition to support tuition deregulation.

In sessions that followed the passage of tuition deregulation, the Egalitarian Coalition filed 70 bills to undo tuition deregulation or moderate future tuition increases. None passed.

During the one-party Republican leadership period, no topic of higher education finance passed that the Free-Market Coalition was not willing to author itself. As shown in Figure A6, members of the Free-Market Coalition authored bills that addressed every topic that passed into law. From the Egalitarian perspective, this meant that the Egalitarian Coalition continued to author higher education bills; however, their bills that passed were confined to policy changes that were in line with the deep core values of the Free-Market Coalition. For example, their policy changes related to student financial aid represented either minor technical changes, an expansion of student loan programs, or the addition of merit criteria to existing policies.

The Free-Market Coalition passed numerous bills that fractured the Egalitarian Coalition. These included performance-based funding (HB9-82, SB1-83), cost containment measures, the strengthening of merit criteria of TEXAS Grants (SB1007-78, SB1227-79, SB1227-79, SB28-82), and new student loan programs (SB4-78, HB1420-78, HB2154-81, HB3579-82, SB1720-83, SB620, SB1232-80).

Within the 22 cost containment measures, the Free-Market Coalition raised rates for excess semester credit hours (HB1890-78 and HB1172-79), capped semester credit hours of degree programs (HB3025-82), created incentives to hold courses during off-peak hours to optimize the use of existing facilities (HB120-80), and made parents with unpaid child support ineligible for state financial aid (HB529-78), to name a few.

Venue Shopping

In our federalist system, there are checks and balances to policymaking based on a division of power across three branches and levels of government. Advocacy coalitions seek out policymaking venues that are to their advantage (Baumgartner & Jones, 1993).

Due to Governor Perry's longevity in office, by 2006, he had appointed members of the Free-Market Coalition to every seat on university governing boards and the Coordinating Board. These appointments enabled the Free-Market Coalition to advance its policy beliefs within these decision-making venues. This led to more policy victories for the Free-Market Coalition, though not without conflict.

On May 21, 2008, the Governor's office convened a meeting of public university regents to address accountability over rising tuition costs and the goal of raising graduation rates. Jeff Sandefer, owner of a for-profit business school, former member of the 21st Century Commission, and director of the conservative Texas Public Policy Foundation (TPPF), a think tank of the Free-Market Coalition, led the meeting. He urged regents to adopt his "Seven Breakthrough Solutions," policy ideas that he considered to be based on free-market principles. Included in his policy solutions were merit pay for teachers and a faculty accountability system that separated research from instruction (Young, 2010).

The regents of the Texas A&M University System were the first to act on the Governor's request. They measured teaching efficiency and productivity based on labor

costs, class sizes, and research grant funding generated by faculty at Texas A&M University at College Station. System administrators graded professors on their profitability to the university and placed them into five categories: “coasters”, “dodgers”, “Sherpas”, “pioneers”, and “stars”. Faculty names were color coded in red or black depending on their overall profitability. The university was engulfed in scandal when the report was posted online, eventually earning the nickname the “Red and Black report.”

The University Coalition responded. Public opposition by Texas A&M faculty was immediate. No faculty offered public support. One of its members, the president of the Association of American Universities (AAU) and former president of the University of Texas Robert Berdahl, wrote to the A&M Chancellor Mike McKinney urging him to resist “ill-conceived calls for 'reform,'” which may cost his flagship university its hard-won membership to the AAU. Berdahl states, "separating research from teaching and oversimplifying the evaluation of faculty does violence to the values that have produced the American universities that are envied and emulated across the globe. Moreover, these proposals directly contradict Texas' stated goal of building more research universities (Berdahl, 2011; Burka, 2012; Greene & Goodwyn, 2013; Hamilton, 2011a)."

The Free-Market Coalition’s efforts to affect university system policies also included the UT System. Investigative reporting by the Houston Chronicle discovered that the Chairman of the UT Board of Regents directed the hiring of a policy analyst who previously worked at the TPPF, where he had authored policy briefs questioning the value of academic research and promoting the “Seven Breakthrough Solutions” (Hamilton, 2011b).

In response, on March 11, 2011, the UT alumni association (Texas Exes), a member of the University Coalition, issued a “call to action” to its members to oppose the hiring of the TPPF analyst. In a letter to alumni, Texas Exes wrote “Call to action—we need your

help to protect the mission and core values of the University of Texas…The UT System Board of Regents, led by Chairman Gene Powell, has hired consultants who have publicly stated the fundamental view that academic research is not valuable and that tenured faculty could be replaced by lower-cost lecturers. These consultants propose a formula that excludes research in valuing faculty. They only want to look at any immediate financial value of research that can be proven on a current basis." UT alumni responded to the call to action (Texas Exes, 2011; Burka 2012; Hamilton, 2011c).

On June 16, 2011, members of the University Coalition, which included former regents, university presidents, higher education donors, and business leaders, formed a new organization called the Texas Coalition for Excellence in Higher Education. In a public letter, the executive committee stated, "We are alarmed that some recommendations being floated by others – from dramatically expanding enrollment while slashing tuition, to separating research and teaching budgets, to seceding from a recognized and respected accreditation organization – are a prescription for mediocrity that would have severe and negative long-term consequences for our state (Texas Coalition for Excellence in Higher Education, 2011)."

On July 6, 2011, Dean Randy Diehl and the Executive Leadership Team of the College of Liberal Arts, all members of the University Coalition, issued a report titled "Maintaining Excellence and Efficiency at the University of Texas at Austin: A response to the seven "breakthrough solutions" and other proposals. The authors of the report reject the "Seven Breakthrough Solutions." They stated, "We do not believe [the 'Seven Breakthrough Solutions' are] the right response to the problems now facing higher education or one that recognizes The University of Texas at Austin's proven levels of efficiency and excellence in educating Texas students… [T]he TPPF proposals seek to approach complex issues with 'simple tools' or 'one-size-fits-all' solutions. If

implemented, they will likely lead to structural changes in higher education that will leave Texas lagging behind other states and drive top students and faculty away (Diehl, 2011)."

Though the "Seven Breakthrough Solutions" were never adopted by public universities, by 2012 the Free-Market Coalition had focused agency agendas on cost containment and degree production. In 2010, the Coordinating Board issued a report outlining a policy agenda for higher education cost efficiencies (THECB, 2011). In 2011, several universities responded to Governor Perry's challenge to produce a $10,000 bachelor's degree program. On Aug 25, 2011, UT System Chancellor Francisco Cigarroa issued a nine-point plan titled "Framework for Advancing Excellence," which among other goals emphasized improving graduation rates and cost efficiencies. In 2012, university regents followed Governor Perry's public request to freeze tuition rates (Burka, 2012).

DISCUSSION

Once Republicans took complete control of state government, the Free-Market Coalition shifted the onus of funding higher education from the state to students and need-based financial aid took on a new purpose that was about mitigating the impact of rising college costs on low-income students. For public universities, direct institutional funding per full-time students declined, but increases in tuition and fees more than made up for the decline.

Another change that followed one-party Republican leadership was who authored bills. During the bipartisan period, the Egalitarian Coalition authored all major policy changes in higher education finance. During this time, no policy change occurred on a topic that members of the Egalitarian Coalition were not willing to author themselves.

Once Republicans took control of state government, the Egalitarian Coalition was sidelined. Major changes in policy were authored by the Free-Market Coalition and often

passed over the objections of a splintered Egalitarian Coalition. The Egalitarian Coalition still authored bills that became law. However, these had to serve some aspect of the Free-Market Coalition's vision of higher education finance.

The final change associated with the change to one-party Republican leadership was the University Coalition's feeling of vulnerability to the more dominant Free-Market Coalition. This was seen in their need to mobilize supporters. Perceived attacks on their independence required the University Coalition to rally supporters and develop a formal organization called the Texas Coalition for Excellence in Higher Education.

Two policies were promoted before and after one-party Republican leadership: TEXAS Grants and dual credit. These policies likely thrived because the Free-Market and Egalitarian Coalitions could sincerely explain their support for these policies. Each coalition had their own reason for supporting TEXAS Grants. For the Free-Market Coalition, TEXAS Grants represented a voucher-type system that empowered lower-income students to act like consumers and help bring market discipline to higher education. For the Egalitarian Coalition, TEXAS Grants represented government taking responsibility for the needs of low-income students who earned admission to college but needed help paying for college. In the case of dual credit, both coalitions told a shared story about college access and affordability.

In conclusion, the ACF has been an effective lens for analyzing the behavior of large numbers of policy actors attempting to affect policymaking over decades. This study identified three advocacy coalitions—the Free-Market, Egalitarian, and University Coalitions—that affected higher education finance policymaking in Texas. This study found that when one coalition dominates a policy subsystem, it is in the interest of the other coalitions to find common ground with the dominant coalition where possible and to collaborate with each other to check the dominant coalition.

Chapter 3

The Effects of Student Grant Aid on Education and Workforce Outcomes during and after College

Approximately 1.8 million first-time undergraduate students enrolled each year in a four-year college during the previous two decades. Approximately 40 percent of these students dropped out before earning their degree (Dunlop Velez, 2014). In a survey of students who left college without a degree, the top reason they gave for dropping out was having unmet financial need. Sixty percent of students who did not graduate reported that combining work and school in their first year in college was "too stressful" (Johnson & Rochkind, 2009). These students wanted to earn a college education. Many put forth great effort in juggling school and work. Yet they fell short in financing a human capital investment that would have increased their expected lifetime earnings by approximately $865,183[14] had they gone from having some college to completing a bachelor's degree (Day & Newburger, 2002).

This represents a market failure that calls for a public policy solution. One policy solution to address this problem has been grant aid that balances eligibility criteria based on financial need with past academic achievement (often referred to as merit).

Starting in 1989, states in the south and southwestern regions of the United States began experimenting with grant programs that struck different balances between need and academic criteria. Louisiana, the first of these states, created a grant aid program in 1989 that was mostly based on need but would later be changed to merit-based (Russell, 2016). By 2014, 11 state grant programs combined need and merit criteria, another 32 state grant

[14] All dollars presented in this study represent 2016 dollars, based on the Consumer Price Index, All Urban Consumers (Bureau of Labor Statistics, 2017).

programs were based solely on need, while another 20 were solely based on a student's prior academic achievement ("45th Annual Survey Report on State-Sponsored Student Financial Aid 2013-2014 Academic Year," 2014; "50-State Policy Database," 2015).

Theoretical Framework

This study relied on the economic theory of human capital investment developed by Becker (1962). This theory asserts that individuals decide on pursuing additional education (in the case of this study, college students decide on continuing their education) based on their expectations of the relative benefits and costs produced by additional education. If a student expects the net benefit of another semester or year of college to be positive, the student will pursue the additional unit of education. The student revisits the decision after acquiring each marginal increase of education.

Based on this economic theory, we would expect grant aid to facilitate college completion through four mechanisms. First, grant aid reduces the direct cost of college, thereby increasing the net benefit of college and preference for college. Second, for college students with financial need, the population of interest of this study, grant aid reduces the amount of time needed to work while enrolled in college, thereby providing the grant-aid awardee more free time. Time not spent working while in college, increases the preference for college because the freed time can be used to improve a student's academic performance, making academic achievement easier. The freed time can also be spent on other activities that reduce the stress associated with college, once again increasing the preference of college. Third, time freed up because of grant aid can also be used to enroll in more courses per semester, thereby shortening a student's time to degree and reducing the opportunity cost of deferred work due to college.

We would also expect grant aid to reduce the need for student debt. And, because students with financial need face credit limits and may also have a limited tolerance for debt, grant aid would increase the share of students pursuing graduate degrees following their undergraduate education. Grant aid would also increase the likelihood of graduate education by increasing the share of students completing a bachelor's degree.

Finally, the economic theory of human capital investment asserts a student's decision to acquire additional education increases their productivity and therefore the student's future earnings.

This study tested the above theoretical implications for grant aid by answering the following research questions. (1) Did receiving an initial TEXAS Grant increase persistence? (2) Did receiving an initial TEXAS Grant increase course enrollment? (3) Did receiving an initial TEXAS Grant reduce the need for employment while in college? (4) Did receiving an initial TEXAS Grant increase the share of students earning a bachelor's degree? (5) Did receiving an initial TEXAS Grant decrease time to degree? (6) Did receiving an initial TEXAS Grant increase the share of students earning graduate degrees? (7) Did receiving an initial TEXAS Grant decrease student loans or other types of aid, respectively? (8) Did receiving an initial TEXAS Grant increase student earnings post college?

Literature Review

Empirical research of student grant aid has affirmed the theoretical implications of human capital investment theory identified above[15]. Existing research has found that grant

[15]I used the online Scout search engine at the library system at University of Texas at Austin, the databases of Academic Search Complete, Education Source, ERIC, and the Google Scholar search engine. I searched for articles published in peer-reviewed journals and dissertations that included the terms university, college, or higher education and grant aid. I limited my search to the last twenty-five years of published research addressing grant aid in US.

aid positively affects student outcomes that lead to degree completion: college enrollment, persistence in college, credit accumulation, and grade point average (GPA). It has also found that grant aid reduces time spent working while enrolled in college, increases degree completion, and shortens time to degree. (Bettinger, 2004; Curs & Harper, 2012; Chen & DesJardins, 2008, 2010; DesJardins, McCall, Ott, & Kim, 2010; DesJardins & McCall, 2010; Dynarski, 2002; Deming & Dynarski, 2009).

I conducted a meta-analysis that found that grant aid of $1,000 increases bachelor's degree completion rates within 11 years by 0.46 percentage points. This meta-analysis relied on six unique studies that used quasi-experimental methods to estimate grant aid effects. Table B1 describes the data and methodology of the meta-analysis (Alon, 2005; Alon, 2007; Bettinger, Gurantz, Kawano, & Sacerdote, 2016; Castleman & Long, 2013; Dynarski, 2008; Goldrick-Rab, Kelchen, Harris, & Bensen, 2016; Scott-Clayton, 2011; Scott-Clayton & Zafar, 2016).

Research has also found that grant aid effects vary across different subgroups of students. Overall, those who realized greater benefits from grant aid include Hispanic and Black students, students with lower high school grade point averages, and students from families of lower income. (Alon, 2007, 2011; Bettinger et al, 2016; Chen & DesJardins, 2008, 2010; Chen & St. John, 2011; S. Dynarski, 2008; Paulsen & St. John, 2002; Singell Jr., 2004; Schwartz, 1985). These findings have suggested that grant aid that weights need-based criteria more than merit-based criteria may produce larger effect sizes.

Finally, a few recent studies have found that grant aid affects longer-term educational and workforce outcomes and that these longer-term impacts may be larger than shorter term outcomes such as bachelor's degree completion. Scott-Clayton and Zafar (2016) found that the merit-based grant program in West Virginia caused a three to four percentage point increase in the probability of earning a graduate degree after 10 years

from first enrolling in college. The grant program also produced positive effects on earnings that were considered meaningful though not statistically significant. Bettinger, Gurantz, Kawano, and Sacerdote (2016) found similar results in their study of a state-funded merit-based grant program in California. They found that grant aid for low-GPA students increased graduate degree attainment by 6.1 percentage points and increased income by approximately 4.7 percent.

Contribution of this study

This study contributed to the existing literature by examining new data, using a natural experimental method, and answering questions that few researchers have investigated. It examined grant aid effects in the largest state yet studied, Texas. Texas's size and diversity provided a sample that allowed for the investigation of more precise questions and the estimation of more precise results. This study used a regression discontinuity research design to evaluate grant aid effects. In addition to college persistence and graduation, it examined the scarcely studied grant effects on outcomes of employment while in college, employment post college, and graduate degree attainment[16]. It also examined how state-funded grant aid reduces student debt and supplants other types of financial aid.

TEXAS GRANTS PROGRAM DESCRIPTION

In 1999, the Texas legislature established the Towards Excellence, Access and Success (TEXAS) grant program with the passage of House Bill 713. Starting with an initial investment of $38 million in fiscal year 2000, the legislature increased TEXAS Grant funding, reaching $367 million in fiscal year 2015. Yet, only 57 percent of those who

16 Course credit earned and grade point average were not examined due to data limitations. Texas colleges began reporting these variables in the fall of 2012. Officials at the Texas Higher Education Coordinating Board considered the first two years of these data to be unreliable.

applied for financial aid and who were eligible for a TEXAS Grant received one during the study period (General Appropriations Acts of 1999 and 2013).

A student who received an initial TEXAS Grant was guaranteed to have their tuition and mandatory fees covered by a combination of state and university funds in their first year. After the first year, awardees were required to demonstrate sufficient academic progress and ongoing financial need. Students lost their TEXAS Grant eligibility if their college GPA dropped below a 2.5, if they earned less than 24 semester credit hours (SCH) per year, if they failed to earn credit in 70 percent of their enrolled classes, or if their Estimated Family Contribution (EFC) rose above $4,000. As shown in Figure B5, initial TEXAS Grant awardees maintained their grant at declining rates with each year in college. In year two, 63 percent of initial awardees maintained their award. This figure dropped to 33 percent in year three, 23 percent in year four, and 9 percent in year five.

EFC is a score defined by the US Department of Education that determines a student's eligibility for federal financial aid and other financial aid programs such as TEXAS Grants. It is intended to represent a relative measure of what a family can contribute to pay for a family member's college education. EFC was a function of numerous factors including the annual household income reported to the IRS, family net worth, the number of household dependents, the number of household dependents enrolled in college, and the costs of college enrollment of all family members enrolled in college. An EFC of $4,000 represented a family of two parents and two children, one of which was in college, with a $60,000 household income.

To qualify for a TEXAS Grant, students were required to meet the following criteria: (1) hold Texas residency; (2) earn a high school diploma classified as college preparatory (in public schools their formal names are Recommended and the more rigorous Distinguished diplomas); (3) enroll in college within 16 months of high school graduation;

(4) enroll in at least 9 semester credit hours of college courses; (5) complete a financial aid application; and (6) have an EFC of $4,000 or less.

DATA

I analyzed data from a state longitudinal data system administered by the University of Texas at Austin. In 2013, the legislature passed legislation creating the current state longitudinal data system (House Bill 2103 by Villarreal) to align education research with state priorities. The legislation required the participation of Texas Education Agency (TEA), the Coordinating Board, and the Texas Workforce Commission (TWC). The administrative data included student-level data of all Texas public school students, student-level data of all public and private college students, and person-level data of all employees working for a Texas employer. Data described the academic and workforce experience of students and their demographic and family background.

This investigation's study sample included students who enrolled in a Texas public university for the first time in the fall semesters of 2004 to 2013. The study sample was further restricted to students who met all the eligibility requirements for receiving a TEXAS Grant other than the financial need criterion defined by the $4,000 EFC cap. The $4,000 EFC cutoff point allowed for a fuzzy regression discontinuity research design.

Table B2 summarizes pretreatment covariates of an unrestricted and restricted sample of the study population, respectively. The restricted sample was limited to students who had an EFC between $2,600 and $5,400, a bandwidth approximately equal to most bandwidths used in this analysis. The unrestricted and restricted samples consist of 358,226 and 38,571 unique students, respectively. The means of pretreatment covariates are nearly identical across the two groups except for EFC.

This study relied on earnings data collected by TWC through the state unemployment insurance program. This data allowed for the investigation of student employment outside of work-study aid. Work-study aid was excluded from earnings because it was considered unique from other types of employment. Work-study aid was associated with work that was related to academics and took place on campus. Existing research has found work-study aid to produce positive effects on persistence and degree completion (DesJardins, Ahlburg, & McCall, 2002), while working in general has been found to have a negative effect (Johnson & Rochkind, 2009). As a result, this study investigated grant aid effects on earnings net of work-study aid.

Data limitations were found with unemployment insurance earnings data. The State of Texas collected wage data only for workers who were employed by Texas employers. Consequently, the study sample excluded students who found employment outside of Texas, who were self-employed, or who were employed by the US federal government. The Coordinating Board estimated the size of this excluded group to be 27 percent of Texas college graduates (Education Pays for Texas, 2016). This data limitation may have biased effect estimates if students in the quasi-treatment group experienced employment and earning levels outside the state of Texas, with the federal government, or as self-employed different from their counterparts in the quasi-control group. The direction of the bias was not clear because of the different categories of workers that were excluded from the study.

RESEARCH DESIGN

I used a fuzzy regression discontinuity (fuzzy RD) research design to identify the impact of TEXAS Grants. As illustrated in the panel subtitled "% Treated" in Figure B2, the probability of treatment dropped from approximately 59 percent to 14 percent at the EFC cutoff point of $4,000. This was a steep drop, but was not a drop from 100 to zero

percent, as a sharp RD design would require. Sharp discontinuity was not present for two reasons. First, the program was not fully funded. Thus, fewer than 100 percent of eligible students received funding. Second, the Coordinating Board allowed for administrative discretion in some cases where extenuating circumstances caused a student's EFC to not accurately reflect a family's ability to contribute to the student's college costs. As a result, individual financial aid offices exercised their administrative discretion and allowed approximately seven percent of students with an EFC greater than $4,000 and less than $5,400 to receive a TEXAS Grant. This administrative discretion had the potential to violate the RD assumption of local randomization at the cutoff point; however, I performed tests that determined this assumption was not violated. A more detailed explanation of these tests follows in the Methodology section.

This study estimated average treatment effects on the treated (TOT). I choose to study TOT effects to answer concerns about current spending and to make inferences about the potential net benefit of covering all eligible participants near the EFC cap.

The treatment variable (D) was a dummy variable indicating whether a student received an initial TEXAS Grant award at matriculation, rather than a measure of dosage, such as the total value of grant aid in dollars or years of tuition covered. Dosage was not used because the variance in doses received was partly endogenous. A student received more grant aid partially based on financial need and partially based on the student's ongoing academic performance in college as described earlier. Thus, students with large amounts of grant aid were more likely to have higher levels of academic achievement relative to those with lower grant aid.

METHODOLOGY

I estimated TOT effect sizes by using an instrumental variable regression analysis of linear probability models. I chose not to use logistic or probit models to ease the interpretation of results. The linear probability models estimated had limited risk of producing results outside of the zero to 100 percent probability distribution range because expected means were found in the middle of the range where the probability distribution is nearly linear in shape (von Hippel, 2015).

My approach included a treatment and outcome equation as shown below in Equation B1 and B2, respectively.

$$D_i = \alpha_0 + \alpha_1 Eligible_i + \alpha_2 EFC_i + \alpha_3 Eligible_i \cdot EFC_i + \epsilon_i \qquad (B1)$$

$$Outcome_i = \beta_0 + \beta_1 \widehat{D}_i + \beta_2 EFC_i + \beta_3 Eligible_i \cdot EFC_i + \epsilon_i \qquad (B2)$$

In Equation B1, D_i was a dummy variable indicating that student *i* received a TEXAS Grant at the start of college (year one). In Equation B1 and B2, $Eligible_i$ was a dummy variable that indicates whether student *i* met the financial need criteria in year one, an EFC at or below $4,000. EFC_i represented student *i*'s Estimated Family Contribution centered at the cutoff point of $4,000. The interaction of $Eligible_i$ and EFC_i allowed the slope of the relationship between EFC and each outcome to vary on either side of the EFC cutoff. The variable ϵ_i represented an error term for student i.

In Equation B2, $Outcome_i$ was one of 10 sets of outcomes studied in this paper. In order of a student's journey through college and beyond, $Outcome_i$ represented the following variables: (1) amount of other types of financial aid received in the first year of college; (2) a dummy for persisting from a prior year to year two, three, and four post

college entry, respectively; (3) a dummy for persisting for four years without interrupting annual college enrollment; (4) annual amount of university semester credit hours enrolled (SCH) in year one, two, three, and four post college entry, respectively; (5) a dummy for earning a bachelor's degree within four, five, six, seven, and eight years post college entry from a Texas private or public university, respectively; (6) a dummy for earning a graduate degree within six, seven, eight, nine, and ten years post college entry from a Texas public or private university, respectively; (7) October to March earnings (net of work-study aid) in year one, two, three, and four post college entry, respectively; (8) a dummy for being employed (outside of federal work-study aid) in year one, two, three, four, five, six, seven, eight, nine, and ten post college entry, respectively; (9), annual earnings (net of work-study aid) in years 1 through 10 post college entry, respectively; and (10) total student debt.

$\widehat{D_i}$ represented a student's predicted probability of treatment. The estimated effect of treatment was represented by β_1.

Standard errors in Equation B1 and B2 were clustered by cohort and the college the student first enrolled.

I tested hypotheses using a two-sided t-test. In the tables that detail effect sizes, I flagged statistical significance at levels below .1, .05, .01, and .001, respectively.

VALIDATING RD ASSUMPTIONS

The internal validity of fuzzy RD rested on the requirement that students or their agents lacked precise control over their estimated family contribution (EFC). To verify this, I interviewed financial aid administrators about the process of calculating EFC. They confirmed that students and their parents are unable to influence this federally defined metric with precision.

I also performed two statistical tests for local randomization. I first conducted the McCrary test, a test for manipulation of the score variable around the cutoff point. I found no evidence of manipulation. As illustrated in Figure B1, the discontinuity estimate equaled 0.012 with a standard error of 0.026. A visual inspection of the density function of EFC revealed no bunching to the left of the EFC cutoff point.

I then ran a second statistical test for discontinuity in pretreatment covariates. As recommended by Lee and Lemieux (2010), I estimated a system of Seemingly Unrelated Regression equations that regressed the pretreatment covariates on treatment eligibility ($ELIG_i$) and the score variable (EFC_i). Equation B3 represented this system of equations, where k represented each of the 14 pretreatment covariates.

$$Z_{ki} = \beta_{k0} + \beta_{k1} Eligible_i + \beta_{k2} EFC_i + \epsilon_{ki} \qquad (B3)$$

I then ran a chi-square test of the joint hypothesis: $ß_{11} = ß_{21} \ldots = ß_{k1} = 0$. It produced a p-value of 0.47, allowing me not to reject the hypothesis of covariate continuity at the cutoff point.

A final verification of the assumption of local randomization was conducted by visually inspecting the probability distributions of the pretreatment covariates conditioned on EFC. As shown in Figure B1, a sample of pretreatment covariates displayed no discontinuity at the cutoff point.

BANDWIDTH SELECTION

An important task in this regression discontinuity design involved defining the neighborhood of observations to the left and right of the cutoff point that would be included in the estimation process. I used the widely accepted Mean Squared Error-optimal

bandwidth method (MSE) first developed by Imbens and Kalyanaraman (2009) to accomplish this task. An optimal bandwidth was estimated for each outcome.

RESULTS

Other Student Aid in First Year of College

This study found that universities supplant other types of financial aid with TEXAS Grant dollars when students receive their first grant award. Receiving an initial TEXAS Grant reduced a student's amount of other grant aid and work-study aid in year one by $631 and $107, respectively, as shown in Table B3.

Students also used TEXAS Grant dollars to replace student loan dollars. Receiving a TEXAS Grant caused students to reduce their student loan dollars in year one by $2,493, as shown in Table B3. This continued year to year. Ultimately, receiving an initial TEXAS Grant caused students to reduce their total student debt by $6,500. This was a reduction in student debt of 24 percent relative to the control group's average student debt of $27,373.

TEXAS Grant effects on other funding sources resulted in relieving financial constraints of awardees not by $6,938 but $3,707 in year one.

Given that a TEXAS Grant covers all tuition and fees, an average value of $6,938 per year for up to five years, we would have expected TEXAS Grants to have a larger impact on student debt. However, as described above, its financial impact was significantly reduced by a high level of attrition in TEXAS Grant renewal awards. As shown in Figure B5, only 63 percent of initial awardees renewed their grant in year two. This figure dropped to 33 percent in year three, 23 percent in year four, and 9 percent in year five.

Enrollment and Persistence

Receiving an initial TEXAS Grant produced no statistically significant effect on persistence conditioned on enrollment in the prior year. However, it produced an impact

on continuous annual enrollment for the first four years of college. Receiving an initial TEXAS Grant increased the probability of continuous enrollment through year four by 5.4 percentage points, as shown in Table B3.

TEXAS Grant aid produced a positive effect on semester credit hours enrolled (SCH)[17], but not at a statistically significant level until year three and four of college. As summarized in Table B3, receiving a TEXAS Grant increased cumulative course enrollment by 2.84 SCH in year three and 5.2 SCH in year four.

Working while Enrolled in College

Receiving an initial TEXAS Grant reduced the amount of time students spent employed outside of work-study aid in the first year of college. As shown in Table B3, receiving an initial TEXAS Grant reduced earnings from October to March by $402 in year one and $450 in year two. These effects represented negative growth rates of 30 percent and 18 percent relative to expected control group earnings, respectively.

Bachelor's Degree Completion

Receiving an initial TEXAS Grant caused students to graduate sooner and increased the overall completion rate. As illustrated in Figure B6 and outlined in Table B3, initial TEXAS Grant awardees completed college at levels higher than their control group counterparts. The grant effect size peaked at the five-year graduation rate then declined as more control-group students graduated with each passing year. Grant aid effects were 5.80, 9.56, 6.73, 6.14, and 3.13 percentage points for completion by year four, five, six, seven, and eight post college entry, respectively. Effects were statistically significant at five, six, and seven years post college entry and marginally statistically significant at four years post

[17] The Higher Education Coordinating Board did not begin collecting data on credit hours earned until 2012.

college entry. The loss of statistical significance in the eight-year graduation rate was likely due to a declining sample size and declining statistical power. Statistical significance was not reached with effect sizes less than five percentage points.

The magnitude of grant effects on degree completion were meaningful when compared to graduation rates of the control group. Receiving an initial TEXAS Grant freshmen year increased graduation rates relative to the control group by 18.2, 17.2, 10.8, 9.3, and 4.7 percent, respectively.

Annual Work and Earnings

Receiving an initial TEXAS Grant produced no statistically significant effects on the probability of employment during any quarter of years one to ten post college entry, as shown in Table B3. However, in general, effect signs were negative during the expected college years and positive post expected college graduation. A similar pattern emerged with grant effects on annual earnings.

In general, students who received an initial TEXAS Grant exhibited a negative effect on annual earnings during college, but a positive effect post expected college graduation, as shown in Table B3. Receiving an initial TEXAS Grant decreased annual earnings by $617 in year one and increased annual earnings by $1,961 in year five post college entry. These effects were marginally statistically significant. All others were not.

Graduate Degree

Receiving an initial TEXAS Grant caused students to increase their likelihood of earning a graduate degree by 4.6 and 6.3 percentage points in year nine and ten post college entry, as shown in Table B3. These effects represented relative growth rates of 51 and 65 percent from the expected graduate degree attainment rate of the control group in year nine and year ten post college entry, respectively.

Robustness Checks

I conducted two robustness checks. The first tested whether grant aid effects were sensitive to changes in the bandwidth. I performed this test by repeating the estimation process after making 10-percent incremental changes to the MSE-optimal bandwidth. As shown in Table B4, the general relationship between receiving an initial TEXAS Grant and student outcomes did not change as the bandwidth varied from 50 to 150 percent of its original size. Although effect sizes changed, the sign and general statistical significance did not.

Second, I tested whether the functional form of the score variable (EFC_i) in relation to each outcome was suitably represented by a linear functional form. I followed a procedure recommended by Imbens and Lemieux (2008) that involved repeating the estimation process with a quadratic functional form of the score variable and then checking to see whether the polynomial terms were statistically significant. As shown in Table B7, the use of a linear functional form of EFC, the score variable, was not invalidated in any of the models.

DISCUSSION

The findings support the expectations derived from the economic theory of human capital investment. Grant aid lowers the cost of continuing a college student's education, thereby increasing the student's preference and ability to complete a bachelor's degree. This study finds that a key mechanism that causes this result is grant aid's effect on time spent working while enrolled in college.

An initial TEXAS Grant causes the average student to spend less time working during the first two years of college. Based on a minimum wage of eight dollars per hour, these effects translate to 50 and 56 fewer hours spent working from October to March in year one and two, respectively. If we apply these effects to the entire academic year, the

effect of an initial TEXAS Grant on hours employed is 75 and 84 fewer hours in a student's first and second academic year, respectively. This is a significant amount of time that can be used to study for classes, enroll in more classes, or engage in campus life or other activities that make college enjoyable. Moreover, the grant effect on bachelor's degree completion is similar in other states.

The convention in grant aid impact studies is to express the impact on bachelor's degree graduation rates per $1,000 of grant aid. Following this convention, TEXAS Grants produces an impact on bachelor's degree completion per $1,000 of 0.50 percentage points by year eight post college entry. This estimate is approximately equal to the estimate derived by the meta-analysis, as shown in Table B1. In the meta-analysis, $1,000 of grant aid causes an increase in bachelor's degree completion within 11 years equal to 0.46 percentage points[18].

TEXAS Grant's effect on annual earnings is negative during expected college years and positive post expected college graduation but with mostly non-statistically significant effect sizes. What explains this pattern of effects on earnings?

The negative effects during the college years are the result of grant aid substituting for earnings from employment. The substitution effect becomes clear after removing the quarters that overlap the summer months and focusing on the fourth and first quarter of calendar year. The effects are also strongest in year one and two when most awardees are receiving grant aid.

The positive effects on earnings post college are weak likely for two reasons. First, TEXAS Grants causes three to six percent more college students to complete college. Its

18 The meta-analysis found significant heterogeneity in the studies analyzed. Therefore, the weighted average effect size should be considered a baseline estimate for comparison purposes, not a reflection of an underlying general effect of grant aid.

larger effect for the awardees group relative to the control group is on shortening their time to degree by one to two years on average. Consequently, effects on earnings post college primarily represent a comparison between two groups of college with one having one to two more years of work experience. Second, receiving an initial TEXAS Grant increases the likelihood students return to school to earn a graduate degree by year nine and ten post college entry. This explains why we see the effect on earnings begin to decline in year six, reach a low point in year eight, then rise and reach its largest effect size in year 10.

Receiving an initial TEXAS Grant increases the likelihood of earning a graduate degree by 6.3 percentage points by year 10 from college entry. This represents a growth of 65 percent relative to the control group's expected outcome of 9.7 percentage points. This is a tremendous boost in graduate degree attainment for students from low-income families. This finding is affirmed by the impact studies of the West Virginia Promise Scholarship (Scott-Clayton & Zafar, 2016) and Cal Grants (Bettinger, Gurantz, Kawano, & Sacerdote, 2016). The merit-based West Virginia Promise Scholarship increased graduate degree completion by three to four percentage points by year 10 post college entry, while Cal Grants improved graduate degree attainment for a low-GPA study sample by 6.1 percentage points.

Future research with data that follow students after year 10 should examine how the TEXAS Grant effect on graduate degree attainment improves earnings.

In conclusion, states seeking to raise their educational attainment rates and raise earnings should advance policies that reduce the cost of college for students who have demonstrated prior academic readiness but lack the financial resources to pay for college. Need-based grant programs that include merit-criteria like TEXAS Grants are an effective and cost-efficient policy tool for lowering the price of college for students who need help.

Chapter 4

The Effects of Dual Credit on Secondary and Postsecondary Student Outcomes

Education remains one of the most salient policy levers to promote economic self-sufficiency for individuals, their families, and the communities where they reside. Furthermore, our technology-driven global economy is making human capital development increasingly necessary for individuals and nations. By 2020, acquiring a postsecondary certificate or degree will be a requirement for nearly two-thirds of all jobs in the United States. Moreover, the benefits of postsecondary education are most crucial for large, diverse states like Texas where the fastest-growing segment of the population is young, economically disadvantaged, and from communities historically underserved by higher education institutions (Carnevale, 2013; Murdock et al., 2014).

Dual-credit programs were created as a strategy for increasing college readiness and access. Dual-credit courses have allowed eligible high school students to enroll in college-level courses and simultaneously earn college and high school credit. Dual-credit programs, also referred to as dual enrollment or concurrent enrollment, were created in the 1980's through local agreements between school districts and their local four-year or two-year colleges.

States created statewide dual-credit policies to promote access to and quality of dual-credit courses. More recently, local communities and states like Texas have adopted dual-credit programs to close educational achievement gaps between low-income students and their higher-income counterparts. Currently, all 50 states in the US have adopted dual-credit policies, with nearly 85 percent of all public high schools having enrolled students in dual-credit programs during the 2010-2011 academic year (Taylor, et al., 2015).

In Texas, where the study population of this investigation was drawn, there were two types of dual credit: academic dual credit and career and technology education (CTE) dual credit. Academic dual credit applied toward a certificate, associate, and bachelor's degree. High school students were eligible to participate in academic dual credit if they were classified as college-ready based on their performance on certain standardized exams[19]. CTE dual credit applied only to community college certificate programs and did not require students to be considered college-ready. In Texas, academic dual credit made up 85 percent of all dual credit earned during the study period. This study focused on the effects of academic dual credit on postsecondary outcomes. Hereafter, this paper refers to academic dual credit simply as dual credit.

Unlike Advanced Placement courses (AP), dual-credit courses resulted in college credit upon satisfactory completion of the course. AP courses resulted in college credit only if the student took an AP exam corresponding to their AP course and achieved a certain exam score. Students had to register to take an AP exam separate from their class registration and pay an additional fee.

Unlike dual credit, the College Board has developed a system for maintaining a national standard of quality associated with AP courses. It has created standardized curriculum for AP classes and college-credit exams. The College Board has also provided professional development for AP teachers.

Theoretical Framework

This study applied the economic theory of human capital investment developed by Becker (1962) to understanding dual credit. This theory asserts that individuals decide on pursuing additional education (in the case of this study, high school students decide on

[19] The standardized exams that determined college-readiness in Texas include the SAT, ACT, the Texas Success Initiative exam, and certain state-mandated high school exams.

continuing their education into college) based on their expectations of the relative benefits and costs produced by the additional education. If students expect the net benefit of additional education to be positive, they will pursue additional education and revisit this decision after acquiring each additional unit of education. This theory has many implications for dual credit.

Dual credit can be understood to facilitate college access and completion through five mechanisms. First, dual credit reduces the direct cost of college by allowing students to earn college credit for free or at a reduced rate, as most dual-credit programs are subsidized either by a student's school district or low-cost community college. Second, dual credit reduces the opportunity cost of foregone wages associated with postsecondary education because students acquire a head start on earning college credits before high school graduation. Third, dual-credit participation provides students valuable information to support their decision to enroll in college by allowing them to assess their ability to complete college-level coursework and develop an interest in college subjects. Fourth, dual credit can increase students' preferences for college by teaching them college-level study skills and advancing their intellectual development. Fifth, dual credit can also increase students' preferences for college by delivering knowledge about how college operates, including college enrollment systems, campuses, and classrooms.

We can expect the first two mechanisms to produce a dosage effect because the cost of college decreases with each increase in dual credit earned. As a result, each additional dual credit earned increases the likelihood of college enrollment and completion. The last three mechanisms reduce the uncertainty of being college-ready. We can expect these mechanisms to have decreasing marginal benefits. This is because once students are aware of their college-readiness and knowledge about how college operates there are few if any more benefits to gain in this regard.

Other consequences of dual credit include effects on timely high school graduation and university admissions. If the benefits of a college education become more accessible because of dual-credit participation, as described above, student preferences for timely high school graduation increase. Dual credit on a student's high school transcript can also increase the likelihood that a university admits a student based on the economic theory of signaling (Spence, 1973; Weiss, 1995)[20]. If dual-credit participation is a signal of college-readiness (an indicator of proactive academic preparation and personal determination) to offices of university admissions, then increases in dual-credit participation can lead to increases in college admissions.

Finally, as college tuition and fees increase, demand for dual credit will increase.

Literature Review

Eight previous studies used advanced quantitative methods to estimate dual credit's impact on student outcomes[21]. They found that dual credit improves rates of high school graduation, college enrollment, college persistence, college GPA, and college degree completion. Those that estimated dual-credit dosage effects also found that enrolling in more dual credit increased the likelihood of college enrollment and completion (Allen and Dadgar, 2012; An, 2013; Hughes, 2016; Giani et al., 2016; Karp et al., 2007; Speroni, 2011; Swanson, 2008).

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[20] The signaling value of education is an economic theory that asserts that part of the value of education is based on its ability to signal to decision makers, such as employers (or, in this study, offices of university admission) that a person who has achieved a certain education is more likely to possess traits desired by the decision maker.

[21] I used the online Scout search engine of the library system at University of Texas at Austin, the databases of Academic Search Complete, Education Source, ERIC, and the Google Scholar search engine. I searched for articles published in peer-reviewed journals and dissertations that included the following terms: dual credit, concurrent enrollment, postsecondary impact, college impact, postsecondary effects, college effects, high school graduation, college enrollment, and college graduation. I limited my search to research addressing dual credit in US.

Dual credit was also found to vary in its effect on degree completion by subject matter. Academic subjects such as English, math, social sciences, science and foreign languages produced larger effects on postsecondary degree completion (associate or bachelor's degree) than non-core courses such as computer science, health, and art. Math dual credit was also found to produce larger effect sizes on degree completion than other core dual-credit subjects (Giani et al., 2016; Speroni, 2011).

With few exceptions, studies found that the effects of dual credit on college enrollment and degree completion were greatest for socioeconomically disadvantaged students (An, 2013; Karp, et al., 2007). One study by Speroni (2011) found that dual credit increased four-year college enrollment more for minority students but did not produce an effect on postsecondary enrollment (an outcome that combined two-year and four-year college enrollment) in general. This suggested that dual credit induced students to enroll in four-year colleges who otherwise would have enrolled in two-year colleges.

Two existing studies reviewed compared dual credit to other types of college preparatory classes including Advanced Placement (AP). Giani et al. (2016) found that dual-credit courses produced larger effect sizes than advanced high school courses (non-AP) on most postsecondary outcomes examined, including bachelor's degree completion rates. Speroni (2011) tested the effect size differences between dual credit and AP on postsecondary enrollment (enrollment in a two-year or four-year college) and on enrollment in a four-year college. She found that dual credit increased postsecondary enrollment greater than AP, while AP increased four-year college enrollment greater than dual credit, all by statistically significant margins. She also found no statistically significant difference between AP and dual credit's impact on bachelor's degree attainment.

Contribution of this Study

This study built on the existing research by using a larger study sample, using a different methodology for controlling for unobserved student and school attributes, and answering new questions.

The study sample was the largest to date. This study followed 11 cohorts of more than three million students who enrolled in over one thousand school districts, from ninth grade in high school up to 13 years post high school entry. Furthermore, the student population studied was from a large and diverse state, Texas.

This study contributed to the existing literature by using a school district-level fixed-effects analysis that emphasized the effects of dual credit *as a policy*. Previous studies individually compared students who did and did not enroll in dual credit, but a student's choice to enroll in dual credit was potentially endogenous and may have produced biased effects if, say, students who already have clear college plans were more likely to enroll in dual credit. To address this weakness, my approach allowed each district to serve as its own control group, effectively controlling for time-invariant district-level confounding variables such as the socioeconomic and demographic composition of a district's student body. This was an important consideration given Texas' highly segregated public-school system (Frankenberg, 2013).

This study also improved upon the existing research by including student outcomes unique to community colleges. This was an important contribution because community colleges have the most to gain from an evaluation of dual credit. They were the higher education partner in nearly all dual-credit programs in Texas and the primary provider in the US. They have the lowest degree completion rates of all higher education institutions. And, most high school graduates who attended college during the study period began at a community college.

This study was also the first to analyze dual-credit effects on university admissions, improving our understanding of the signaling value dual credit may produce in regard to university admissions. It followed students up to thirteen years from when they first enter high school to estimate dual-credit effects on graduate degree attainment. It explored dosage effects of dual credit to determine whether effect sizes plateau at higher levels of participation. And it furthered the comparative analysis between AP and dual credit by examining the dosage effects of each type of early college coursework.

Finally, this study made new contributions to the study of dual-credit program design. This study investigated how dual-credit effect sizes varied across different program attributes, though endogeneity issues made these findings tentative. Specifically, this study explored whether dual-credit effects varied between English, math, science, social science, arts, foreign languages, computer science, and "other" subjects. For a limited set of shorter-term outcomes (high school graduation, university application, university enrollment, and community college enrollment, associate degree completion), the study investigated whether instructors with a doctoral degree produced a different impact from those with a master's degree; whether impacts varied by instruction mode (traditional face-to-face classroom instruction, instruction with teacher and students connected by video, computer-based instruction, or a combination of computer and classroom instruction referred to as blended learning in this paper); and whether dual-credit courses located on a high school campus produced a different impact from those located on university or community college campuses.

In summary, the research questions this study attempted to answer include the following:

1. Did dual-credit participation cause more students to pursue a two- and four-year college degree, respectively?

2. Did dual-credit participation cause an increase in university admissions?
3. Did dual-credit participation increase educational attainment levels, measured by increasing rates of high school graduation and associate, bachelor's, and graduate degree attainment, respectively?
4. Did dual-credit participation decrease time to degree for students pursuing an associate and bachelor's degree, respectively?
5. Did marginal increases in dual-credit participation produce positive marginal benefits – was more dual credit better?
6. Were dual-credit effects on student outcomes larger than those produced by Advanced Placement (AP) courses?
7. Did dual-credit effect sizes vary by course subject, mode of instruction, location of instruction, or instructor's highest degree earned?

POLICY BACKGROUND

Dual-credit courses studied were the product of collaborations between school districts and colleges. In Texas, community colleges were the primary higher education sponsor of dual-credit programs. These collaborations were created at the local level with limited state oversight, while other states maintain a state-level regulatory framework (Taylor, Borden & Park, 2015).

There was great variety in dual-credit program design. In addition to varying by subject, dual-credit courses were taught within different settings (high school campus, community college campus, university campus, or other location such as a place of work, military facility, or correctional institution). They used different modes of instruction (face-to-face instruction, video, computer-based content only, or a blend of online coursework and face-to-face instruction). And, they were instructed by teachers with a master's degree

or doctorate. (Reporting and Procedures Manual Texas for Community, Technical, and State Colleges, 2016).

Who taught dual-credit classes was a significant concern. Dual-credit instructors in Texas must hold either a master's degree or a doctorate. University faculty and administrators have questioned the rigor of dual-credit courses, which are most commonly taught by instructors with a master's degree only[22].

In 1995, the Texas legislature authorized community colleges to offer dual-credit programs in partnership with their local school districts by passing House Bill (HB) 1336. Though Texas was not an early adopter of dual-credit policy, it tried to catch up to other states. From 1995 to 2015, the legislature passed 20 bills incentivizing the creation of dual-credit programs and removing barriers to increased enrollment and program expansion. For example, in 2003, the Texas legislature passed HB 415 to allow both school districts and colleges to be paid by the state for the provision of dual-credit instruction. Three years later, the Texas legislature passed HB 1, requiring all public high schools to provide students access to 12 semester credit hours (SCH) of college credit through AP, International Baccalaureate, or dual-credit courses. In 2015, the Texas legislature prohibited the Texas Higher Education Coordinating Board (Coordinating Board) from adopting rules that limit the total number of dual-credit courses a student could enroll in (HB 505). In the same session, the Texas legislature also removed regulations that limited colleges from providing dual credit outside of their service area.

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[22] The popular press has documented this perspective on dual credit held by university administrators. The following quote about dual credit was one example. "In terms of the rigor of the community college programs, it is a little bit of a mixed bag," [Jim Miller, Dean of Admissions at Brown University] said. "We know what an AP calculus class is. We're not sure what a calculus course is at the myriad community colleges" (Mellon, 2008).

Dual credit received bipartisan support from two advocacy coalitions, one dominated by Republican legislators who prioritized cost efficiencies in higher education and one dominated by Democratic legislators who prioritized college access and completion, particularly for low-income and minority students. Members of both coalitions promoted dual credit as a cost-efficient and egalitarian solution for raising educational attainment levels in the context of rising tuition rates and declining state funding for higher education.

Dual credit was also popular with public school administrators and students. School districts offering dual credit grew from 75 percent in 2001 to 92 percent in 2011, as shown in Figure C1. Within dual-credit districts, student participation in dual credit grew from 16 percent of the high school cohort who started high school in 2001 to 27 percent of the 2011 cohort, as shown in Figure C2.

Most important for this study, school districts adopted dual-credit policies at different times and experienced unique fluctuations in student participation in dual credit. It was this variation that permitted the identification of dual-credit effects. As shown in Table C1, only eight percent of school districts experienced consistent positive growth across time. School districts experienced fluctuations in dual-credit participation that varied from one to seven declines across 11 cohorts, with the largest share experiencing four declines. Furthermore, as shown in Figure C1, dual-credit adoption varied across major urban, major suburban, non-metropolitan, rural, charter, and other school districts by year. At districts that offered dual credit, student participation in dual credit also varied across these categories of school districts, as shown in Figure C2.

DATA

This study analyzed data from the Education Research Center at the University of Texas at Austin (UT ERC). The UT ERC data used included student-level administrative data collected by the Texas Education Agency (TEA) and the Coordinating Board. The data described the secondary and postsecondary education of public school students who entered high school in academic years ending in 2001 to 2011. The data also described the demographics, household poverty status, and performance on state-required tests of students.

The student population included in the analysis amounted to 3,321,366 public high school students who entered 2,554 high schools in 1,173 public school districts (district). I collapsed the student-level data into district-level data to form a data set of 1,173 unique districts with up to 11 student cohorts of data. I defined a cohort as the group of students who entered high school in the same year. As shown in Table C2, the pooled sample of 11 district-level cohorts equaled 12,021 observations and varied by student demographics, performance on state-mandated test scores, and dual credit earned by program attributes.

Data Limitations

TEA and the Coordinating Board used separate systems to collect data describing student enrollment in dual credit. A study of the two systems found that approximately a quarter of TEA-identified dual-credit students were not identified as dual-credit students by the Coordinating Board, and vice versa. The systems also lacked a course "crosswalk" to link course data (Eklund, 2009). As a consequence, researchers that modeled the effects of dual credit in Texas had to choose between the two sources of dual-credit data.

I chose to rely on TEA data to answer my primary research questions, questions one through six, because TEA data allowed me to account for AP credit earned. I used

Coordinating Board data to explore heterogeneous effects of dual credit by instruction mode and location, data absent from TEA data.

A second data limitation was associated with the identification of heterogeneous effects by type of instructor, and teaching mode and location. As shown in Table C2, the observation counts associated with these variables was approximately one-fifth of the other variables. This was because the state of Texas did not begin collecting these variables until fiscal year 2012. As a result, heterogeneous effects by these attributes could only be examined for the 2008 cohort and for outcomes that occurred within two years from the cohort's expected high school graduation. Consequently, the findings of heterogeneous effects were tentative.

RESEARCH DESIGN & METHODOLOGY

Students voluntarily enrolled in dual credit. This posed a challenge to estimating the effects of dual credit unbiased by self-selection, as described earlier. For example, one would expect students with high aspirations for college to be more likely to enroll in dual credit and more likely to earn a college degree. Consequently, not controlling for the unobserved college aspirations of students would overstate dual-credit effects on college completion.

This study addressed the presence of unobserved variables by using a panel regression with school district fixed effects and probability weights. Over multiple years, a set of explanatory and outcome variables were observed for each cohort of a district. A school district's changes in dual-credit participation were then compared to its corresponding changes in student outcomes. With this within-district comparison, each school district served as its own control group over time.

School district fixed effects controlled for unobserved variables that do not vary with time, such as location and legal structure. It also controlled for much of the effects of attributes that, though not strictly time-invariant, were relatively stable across a decade, such as the socioeconomics of the student population, capital infrastructure, school culture, and the quality of faculty.

Probability weights were included to ensure that each school district contributed to the identification of dual-credit effects in proportion to their student population. Probability weights were based on a school district's average student population during the study period relative to the sum of average student populations of all districts.

I chose to estimate the effect of dual credit as a school district (district) policy and not a school policy. I did so because district superintendents, not school principals, decided to enter into dual-credit partnerships with an institution of higher education. They were also the decision-makers with the authority and responsibility to increase dual-credit participation.

A threat to the internal validity of this research design involved trends. If the treatment variable varied along a time pattern common to other plausible explanatory variables not accounted for, these omitted variables would bias estimated effect sizes. This study mitigated time trend threats by including a fixed effect for each year. Moreover, as mentioned earlier, this research design benefited from significant variance in dual-credit participation that fluctuated cohort to cohort within each school district. This variance mitigated time trend threats.

A final threat to internal validity was district-specific trends. The statewide population of economically disadvantaged students grew by 10 percentage points from 49 percent in 2001 to 59 percent in 2011. However, districts were declining in affluence at different rates and some were even growing in affluence. These district-specific trends

affected the likelihood of dual credit participation and expected postsecondary outcomes, thereby confounding the relationship between dual-credit participation and postsecondary outcomes. To mitigate this threat, this study controlled for changes in a district's economically disadvantaged student population and changes in its race and ethnic composition by including corresponding covariates.

This study analyzed the following student outcomes: (1) the percentage of students who graduated from high school within four years of entering high school; (2) the percentage of students who applied to a Texas public university (private school data was not available) before high school graduation; (3) the percentage admitted to a Texas public university before high school graduation (private school data was not available), (4) the percentage enrolled in a Texas public community college in the fifth year from entering high school (or the first year after the cohort's expected high school graduation year); (5) the percentage enrolled in a Texas university (public or private) in the fifth year from entering high school; (6) the percentage who earned an associate degree in Texas by the sixth year and (7) eighth year from entering high school; (8) the percentage who earned a bachelor's degree in Texas within eight, (9) ten, and (10) twelve years from entering high school; and (11) the percentage who earned a graduate degree in Texas within twelve years and (12) thirteen years from entering high school. As described above, all outcomes occurred in years from when a cohort entered high school. Hereafter, any reference to when an outcome occurs was in relation to high school entry.

This study answered its seven research questions by estimating six school district fixed effects regression equations using linear probability models. Linear probability models were used instead of logistic or probit models to ease the interpretation of results. The linear probability models estimated had limited risk of producing results outside of the zero to 100 percent probability distribution range because expected means were found

in the middle of the range where the probability distribution is nearly linear in shape (von Hippel, 2015).

In the first model, I estimated an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_{ij} = \alpha_i + \lambda_j + \beta_1 AP_{ij} + \boldsymbol{\beta_2 Z_{ij}} + \beta_3 DC_{ij} + \varepsilon_{ij} \quad \text{(C1)},$$

where α_i was the cohort fixed effect of cohort i, λ_j was the district fixed effect of district j, DC_{ij} represented the share of students earning at least one dual credit of cohort *i* of district *j*, and AP_{ij} represented the share of students earning credit in at least one AP course of cohort *i* of district *j*. The effect size of AP and dual-credit participation was represented by β_1, and β_3, respectively. Earning AP credit meant a student successfully completed an AP class, it did not necessarily mean a certain score was achieved on an AP test.

$\mathbf{Z_{ij}}$ represented an array of time-varying attributes of cohort *i* of district *j*, including demographic and socioeconomic composition of the student body; share of immigrant students; and average scores of eighth-grade math and reading state-standardized exams (the grade before dual-credit eligibility), respectively. The error term of cohort *i* of district *j* was represented by ε_{ij} and was clustered by district to adjust for serial correlation of the errors across nearby years (Cameron & Miller, 2015). Equation C1 represented the basic model that all others are built on.

In the second regression model, I examined the effects of changes in the average amount of dual credit and AP credit earned. These explanatory variables were different from those in the first model because they could be increased by having the existing pool of dual-credit students earn more dual credit. As described earlier, as students earned more dual credit, their likelihood of enrolling and graduating from college should have increased. The second model tested this hypothesis.

A district's average amount of dual credit earned per cohort better accounted for dosage; however, it was an imperfect measure of dosage. This was because a given average could reflect many students earning few dual credit or few students earning many dual credits. Consequently, the correct interpretation of the effect size was from the district's perspective. The effect of average dual credit earned represented what follows when a district increased the average dual credit earned in a given cohort.

In the second model, I estimated an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_{ij} = \alpha_i + \lambda_j + \beta_1 AP\_DOSE_{ij} + \beta_2 AP\_DOSE^2{}_{ij} + \boldsymbol{\beta_3 Z_{ij}} + \beta_4 DC\_DOSE_{ij} + \beta_5 DC\_DOSE_{ij}^2 + \varepsilon_{ij}, \quad \text{(C2)}$$

where quadratic functional forms for average AP and dual credit earned for cohort *i* of district *j* replaced AP_{ij} and DC_{ij}, and the remaining regressors from Equation C1 were included. I used a quadratic functional form in this model so that I could examine whether the effects of average dual credit plateaued or declined as average dual credit increased. β_4 and β_5 measured the effect of a one-unit (equivalent to three SCH) increase in dual credit earned. β_1 and β_2 measured the effect of a one-unit (equivalent to three SCH) increase in average AP credit earned.

The third model investigated heterogeneous effects of average dual credit earned by course subject. I modeled an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_{ij} = \alpha_i + \lambda_j + \beta_1 AP_{ij} + \boldsymbol{\beta_2 Z_{ij}} + \boldsymbol{\beta_3 DC\_SUBJECT_{ij}} + \varepsilon_{ij}, \quad \text{(C3)}$$

where $\mathbf{DC\_SUBJECT_{ij}}$ represented an array of regressors that respectively measured the average dual credit earned in math, English, science, social sciences, foreign languages, health, arts, computer science, and all other dual-credit subjects for cohort *i* of district *j*. $\boldsymbol{\beta_3}$ was an array that respectively measured the effects of changes in average dual credit earned by subject. In this model and the following ones, the functional form of average dual credit earned was made linear to simplify the analysis.

The fourth model investigated heterogeneous effects of average dual credit earned by instructor's highest degree. I modeled an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_i = \alpha_i + \lambda_j + \beta_1 AP_{ij} + \boldsymbol{\beta_2 Z_{ij}} + \boldsymbol{\beta_3 DC\_INSTRUCTOR_{ij}} + \varepsilon_{ij}, \quad \text{(C4)}$$

where $\mathbf{DC\_INSTRUCTOR_{ij}}$ represented an array of regressors that respectively measured the average amount of dual-credit earned of cohort *i* of district *j* that was taught by an instructor whose highest degree was a master's degree and one whose highest degree was a doctorate. $\boldsymbol{\beta_3}$ was an array that respectively measured the effects of changes in average dual credit earned by type of instructor.

The fifth model investigated heterogeneous effects of average dual credit earned by mode of instruction. In this analysis, I modeled an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_{ij} = \alpha_i + \lambda_j + \beta_1 AP_{ij} + \boldsymbol{\beta_2 Z_{ij}} + \boldsymbol{\beta_3 DC\_Mode_{ij}} + \varepsilon_{ij}, \quad \text{(C5)}$$

where $\mathbf{DC\_Mode_{ij}}$ represented an array measuring the average dual credit earned of cohort *i* of district *j* by face-to-face instruction, instruction by video, blended learning (which is a

combination of face-to-face and computer-based instruction), and computer-based instruction with no live instructor, respectively[23]. $\boldsymbol{\beta_3}$ was an array that respectively measured the effects of changes in average dual credit earned by mode of instruction.

The sixth and final model investigated heterogeneous effects of average dual credit earned by location of instruction. In this analysis, I modeled an expected outcome for cohort *i* of district *j* (Y_{ij}) as

$$Y_{ij} = \alpha_i + \lambda_j + \beta_1 AP_{ij} + \boldsymbol{\beta_2 Z_{ij}} + \boldsymbol{\beta_3 DC\_LOCATION_{ij}} + \varepsilon_{ij}, \quad \text{(C6)}$$

where $\boldsymbol{DC\_LOCATION_{ij}}$ represented an array that measured the average dual credit earned by cohort *i* of district *j* on a high school, community college, university, or other site, respectively. $\boldsymbol{\beta_3}$ was an array that respectively measured the effects of changes in average dual credit earned by location of instruction.

I tested hypotheses using a two-sided t-test. In describing the findings, I flagged statistical significance at p-value levels below .1, .05, .01, and .001, respectively.

RESULTS

Dual-credit Participation Effects

In this subsection, I describe expected changes in student outcomes associated with a 10-percentage point increase in dual-credit participation. I also provide a growth rate relative to a baseline estimate of the expected outcome when dual-credit participation was zero.

[23] I combined instruction by one-way video and two-way interactive video into one category and combined distance learning with blended learning. Distance learning involves a minimum of 15 percent of the instruction time delivered through face-to-face instruction.

As shown in Table C3, a 10-percentage point increase in dual credit was associated with an increase in high school graduation by year four by 0.66 of a percentage point. This was a 0.91 percent growth rate relative to the baseline of 73 percent.

Dual-credit effects on postsecondary outcomes also emerged. For every 10-percentage point increase in dual-credit participation, the percent of students who applied to a Texas public university while in high school increased by one percentage point. This was a growth rate of 3.84 percent relative to the baseline of 26.0 percent.

For every 10-percentage point increase in dual-credit participation, the percent of students admitted to a Texas public university while in high school increased by 0.96 of a percentage point. This was a growth rate of 4.36 percent relative to the baseline of 22.1 percent.

For every 10-percentage point increase in dual-credit participation, the percent of students who enrolled in a Texas public or private university the year following their expected high school graduation (year five from entering high school) increased by 0.82 of a percentage point. This was a growth rate of 4.1 percent relative to the baseline of 20 percent[24].

Increases in dual-credit participation did increase community college enrollment but only at a marginally statistically significant level. For every 10-percentage point increase in dual-credit participation, the percent of students who enrolled in a Texas community college the year following their expected high school graduation (year five from entering high school) increased by 0.23 of a percentage point. This was a growth rate of 0.75 percent relative to the baseline of 31 percent.

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[24] The difference between the baseline percent of students admitted to a Texas public college versus the percent enrolled in a Texas private or public college did not represent summer melt. The percent admitted did not include private colleges, though they were included in the enrollment figures.

Increases in dual-credit participation were associated with increases in associate degree completion. For every 10-percentage point increase in dual-credit participation, the percent of students who earned an associate degree within two years from expected high school graduation (or year six from entering high school) increased by 0.21 of a percentage point. This was a growth rate of 25.7 percent relative to the baseline of 0.8 percent.

Dual credit continued to affect associate degree completion rates by year eight from high school entry (or four years from expected high school graduation). For every 10-percentage point increase in dual-credit participation, the percent of students who earned an associate degree by year eight increased by 0.18 of a percentage point, a relative growth rate of 5.3 percent from its baseline estimate of 3.3 percent.

Dual credit also improved bachelor's degree completion rates. For every 10-percentage point increase in dual-credit participation, the percent of students who earned a bachelor's degree by year eight, ten, and twelve after entering high school increased by 0.51, 0.56, and 0.63 of a percentage point, respectively. These were respective growth rates of 7.4, 3.6, and 3.5 percent relative to baseline rates of seven percent within eight years from entering high school, 15.5 percent within ten years from entering high school, and 18.0 percent within twelve years from entering high school.

Finally, dual credit affected graduate degree completion. For every 10-percentage point increase in dual credit, the percent of students who earned a graduate degree within 12 years after entering high school increased by 0.08 of a percentage point. This was a growth rate of 3.45 percent relative to a baseline of 2.2 percent.

Dual credit's effect on graduate degree completion within 13 years after entering high school was not statistically significant though it was positive.

Was More Dual Credit Better?

The second model of this study investigated whether school districts improved student outcomes by increasing the average amount of dual credit earned measured in semester credit hours (SCH). As shown in Table C4 and illustrated in Figure C3, this study found more dual credit improved student outcomes.

School districts improved four-year high school graduation rates by increasing average dual credit earned up to nine SCH. At nine SCH of average dual credit, high school graduation rates reached 77 percent; afterwards high school graduation rates began to decline.

School districts improved university application, admissions, and enrollment rates by increasing average dual credit earned. University application rates rose to 44 percent at 27 SCH. Admission rates increased to 38 percent at 24 SCH. University enrollment increased to 39.5 percent at 30 SCH.

School districts decreased community college enrollment in the year following high school graduation with every increase in average dual credit earned after 3 SCH. But with each increase, they exponentially improved associate degree completion. Associate degree completion by year six reached 48 percent at 30 SCH. Similarly, dual credit effects on associate degree completion by year eight reached 27 percent at 24 SCH but stopped being statistically significant at higher levels of average dual credit earned. Associate degree completion could rise as community college enrollment declined because high school students were earning their associate degree when they graduated from high school or during their enrollment at a four-year college.

Increased levels of dual credit had the greatest impact on bachelor's degree attainment. By year eight, bachelor's degree attainment reached 52 percent at 30 SCH. By

year 10, it reached 77 percent at 30 SCH. By year 12, bachelor's degree attainment reached 67 percent at 27 SCH.

Finally, school districts improved graduate degree attainment by year 12 and 13 by increasing average dual credit. Graduate degree attainment by year 12 reached 5.1 percent at 12 SCH of average dual credit earned. It equaled 4.7 percent by year 13 when average dual credit earned reached 9 SCH.

Dual-credit effects Compared to Advanced Placement (AP)

Equation C1 compared the effect of students earning at least one credit of dual credit to one credit of AP. As shown in Table C3, AP effects were larger than and statistically distinct from dual credit in seven of the twelve outcomes examined. The AP advantage occurred with the following outcomes: high school graduation, university application, community college enrollment, bachelor's degree completion at year 10 and 12, and graduate degree attainment by year 12 and 13.

Equation C2 compared the effect of students earning increased levels of dual credit to increased levels of AP. As shown in Figure C3, increases in dual credit earned produced greater benefits that were statistically distinct from AP for every student outcome.

The most meaningful difference found between AP and dual credit was that increasing levels of average dual credit were associated with larger increases in bachelor's degree completion. Average dual credit of 30 SCH increased the rate of bachelor's degree attainment at year eight and ten to 52 percent and 77 percent, respectively. In contrast, average AP caused bachelor's degree attainment to peak at lower levels. And, the statistical significance of AP effects was generally lost after 18 SCH of average AP earned. Average AP of 18 SCH increased the rate of bachelor's degree attainment at year eight and ten to ten percent and 16 percent, respectively.

Dual-Credit Effects by Subject

This study found that dual-credit subjects were not equally beneficial, and one decreased bachelor's degree attainment as shown in Table C5. The effect sizes described below were statistically significant based on a two-sided t-test and p-value of less than .05. They were also statistically distinct from each other, unless otherwise noted.

High School Graduation

A three-SCH increase in a district's average foreign languages and social science dual credit was associated with an increase in high school graduation within four years by 8.5 and 1.9 percentage points, respectively. A three-SCH increase in a district's average math dual credit was associated with a decrease in high school graduation by 3.4 percentage points.

Texas Public University Application

A three-SCH increase in a district's average foreign languages, English, and social science dual credit was associated with an increase in university application rates by 8.7, 4.0, and 3.4 percentage points, respectively.

Texas Public University Admissions

A three-SCH increase in a district's average foreign language, English and social science dual credit was associated with an increase in university admission rates by 7.8, 3.9, and 3.8 percentage points, respectively.

Texas Public or Private University Enrollment

A three-SCH increase in a district's average foreign languages, social science, and English dual credit was associated with an increase in Texas university enrollment rates of 5.5, 3.6, and 2.6 percentage points, respectively.

Texas Community College Enrollment

A three-SCH increase in a district's average computer science dual credit was associated with an increase in Texas community college enrollment of 11.4 percentage points.

Associate Degree Attainment

A three-SCH increase in a district's average "other", art, science, English, and social science dual credit was associated with an increase in associate degree attainment by year six of 14.2, 9.4, 3.3, 1.3, and 0.5 percentage points, respectively. When the time frame for associate degree completion was extended to year eight, the only subject that maintained its effect on associate degree attainment was English with an effect sizes of 2.6 percentage points.

Bachelor's Degree Attainment

A three-SCH increase in a district's average computer science, foreign languages, English, social science, and math dual credit was associated with an increase in bachelor's degree attainment by year eight of 5.3, 3.4, 3.3, 2.2, and 2.0 percentage points, respectively. A three-SCH increase in a district's average health dual credit was associated with a decrease in bachelor's degree attainment by year eight of 4.3 percentage points.

When the time frame for bachelor's degree completion was extended to year 10, the subjects that maintained their effect were computer science, English, and social science with effect sizes of 11.4, 4.5, and 2.6 percentage points, respectively. As before, a three-SCH increase in a district's average health dual credit was associated with a decrease in bachelor's degree attainment by year 10. The negative effect size of average health dual credit equaled 7.2 percentage points.

When the timeframe was extended further to year 12, a three-SCH increase in a district's average English, math, and social science dual credit was associated with an increase in bachelor's degree attainment of 4.6, 4.1, and 3.3 percentage points, respectively.

Graduate Degree Attainment

No subjects produced a statistically significant effect on graduate degree attainment.

Dual-Credit Effects by Instructor's Highest Degree

In the regression model that explored heterogeneous effects by instructor type, point estimates of regression coefficients varied, as shown in Table C6. However, formal hypotheses tests that compared the statistical equivalence of coefficients found no statistically significant difference between the point estimates.

Dual-Credit Effects by Instruction Mode

Limited variation was found in the relationship between student outcomes and dual credit by instruction mode. Dual-credit classes taught exclusively by computer produced the largest and statistically distinct effect on high school graduation rates. A three-SCH increase in average dual credit taught via computer was associated with a 23-percentage point increase in high school graduation rates as shown in Table C7.

No other mode of instruction produced a statistically unique effect size.

Dual-Credit Effects by Instruction Location

Limited variation was also found in the relationship between student outcomes and dual credit taught at different locations. As shown in Table C8, dual credit taught on a high school campus produced a larger and statistically distinct effect on associate degree completion by year six than dual credit taught at other locations. One interpretation for this

could be that dual credit on a high school campus may have caused students to raise their college aspirations to university enrollment from community college enrollment thereby decreasing associate degree completion.

DISCUSSION

Texas is pursuing a goal of raising the postsecondary attainment of 25- to 34-year-olds to 60 percent by 2030. To reach this goal, the state needs to increase its share of students enrolling and completing college. This study finds that dual credit is a systemic innovation that can help the state accomplish these objectives. (THECB, 2017).

Increases in dual-credit participation led to more timely completion of associate and bachelor's degrees and overall increases in associate, bachelor's and graduate degree attainment. Furthermore, the results of this study suggest that more dual credit is better. As school districts increase their average amount of dual credit earned up to 30 semester credit hours, the rates of college enrollment and degree completion continuously increase.

This study finds no evidence that dual credit produces a positive signal to university admission's offices of college readiness. Increases in college enrollment associated with dual-credit participation are driven by increases in college application rates, not admission rates.

This study also finds evidence to suggest that education leaders can increase dual-credit impacts on associate and bachelor's degree completion by prioritizing math, English, social sciences, foreign languages, science, and computer science dual credit. In contrast, the study finds that art, health, and "other" subjects only produced positive effects on associate degree completion but not bachelor's degree completion.

This study finds no evidence to suggest that instructors with doctoral degrees improve student outcomes more than those with only a master's degree. And, it finds no

evidence to suggest that dual credit offered on a university or community college campus is more impactful on college enrollment patterns than dual credit on a high school campus. Impact on degree attainment was not fully identified due to data limitations discussed earlier.

Taken together, these findings suggest that districts can realize efficiencies in their dual-credit program by prioritizing core academic subjects, using instructors who hold a master's degree only, and locating dual-credit courses on their high school campuses.

School leaders often question which type of early college coursework is most likely to help prepare students to succeed in college, dual credit or AP. The findings suggest that if school leaders must choose between the two, dual credit offers greater benefits as students accumulate multiple credits. Furthermore, dual credit was the only college-prep curriculum to significantly improve outcomes for community college students seeking an associate degree–Texas's largest share of college students.

This study finds the most important difference between AP and dual credit is that increased levels of average dual credit are associated with larger increases in bachelor's degree completion rates than AP. This difference may be explained by AP credit not simultaneously representing college credit, unlike dual credit. To earn college credit, AP students must register for an AP test, pay for it, take the exam, and achieve a certain score. These four extra hurdles likely weaken the association between AP and improved postsecondary outcomes.

The findings of this study are affirmed by the existing research summarized in the literature review with one exception. This study finds that math dual credit does not produce effects on college access and degree completion greater than English or social science dual credit. Given the current push at the highest levels for STEM education, this finding that English and social science dual credit provides equal, and in some cases greater

impact on student outcomes, is an important reminder not to forget the benefits of a strong humanities foundation.

In summary, dual credit is a systemic education innovation that integrates a historically fragmented education system to increase postsecondary achievement. The findings of this study provide evidence to policymakers to support high schools and colleges in expanding dual credit, increasing the amount of dual credit earned per student, and prioritizing dual-credit courses that produce the largest effects. Any policy capping dual-credit enrollment per student at less than 30 SCH should be rejected. To accomplish this agenda, school districts will need to overcome a shortage of teachers who are qualified to teach dual credit and institutions of higher education will need to embrace their role as partners with secondary education.

Chapter 5

Conclusion

The Free-Market Coalition analyzed in Chapter 2 has led the Texas higher education subsystem since 2003. It has pursued the dual goal of raising the education levels of Texas residents without increasing overall per-capita state spending. In the context of a growing population with growing needs in health, transportation, water, and other areas, the governing coalition has pursued its dual education/fiscal policy goal by shifting the financial responsibility of higher education to others (local governments, universities, and students and their families) and creating the need for innovation in response to state government austerity and greater public transparency of student outcomes.

While they have met their fiscal austerity goal, Figure D1 suggests the Free-Market Coalition will not reach its ambitious goal of raising the percent of 25- to 34-year-olds earning a college certificate or degree to 60 percent by 2030 (often referred to as the 60x30 goal) unless there is a change in the historic growth rates of college access and completion. Figure D1 illustrates educational attainment levels of cohorts of Texas students by the year in which they entered eighth grade. The rates of postsecondary degree or certificate attainment are based on following students up to six years after their expected high school graduation date. The percent of students earning a postsecondary degree or certificate increased with each passing cohort, but by very slight gains. As shown by Figure D1, 21.1 percent of students who entered eighth grade in 2000 earned a postsecondary degree or certificate. Six cohorts later, 25.2 percent of students who entered eighth grade in 2006 earned a postsecondary degree or certificate. This represented an average annual growth rate of three percent. Based on this growth rate, the

projected percent of 25- to 34-year-olds who enrolled in a Texas public school and who went on to earn a postsecondary degree or certificate from a Texas public or private institution of higher education equaled 32.5 percent by 2030.

This projection did not account for Texas private-school students, Texas students who leave the state for college and return, or students from other states who move to Texas. Despite these missing subgroups, if Texas does not significantly increase the rate of postsecondary access and completion of its public-school students, which comprise approximately 95 percent of its school-age population (NCES, 2017), it will not meet its 60x30 goal.

Conservative state policymakers should consider the full economic impact of targeted education investments on the state's economy. They can achieve their education goal and improve the state's economy by investing in programs that have proven effects on raising the education and productivity of their workforce. These education investments can be justified based on their long-term effect on raising state and local tax revenue, reducing dependence on public services, and increasing household incomes. TEXAS Grants is an example of a targeted policy that produces a positive return on investment to the state.

The TEXAS Grant program produced a 4.4 percent return on investment to the state's economy, or a net economic benefit equal to $1.4 billion, as outlined in Table D1. This calculation accounted for TEXAS Grants' impact on taxpayers, student debt, and lifetime earnings of students. Taxpayer impacts accounted for taxes paid, social program costs, incarceration costs, and the cost of education paid for by taxpayers (Carroll & Erku, 2009). The marginal increase in lifetime earnings represented the marginal benefit of moving an average student from having some college to having a bachelor's degree. It also accounted for the marginal benefit of earning a graduate degree (Day & Newburger,

2002). These estimates, unlike the data used in this current study, spanned forty years of a person's working life.

In addition to increasing state spending for targeted programs, there exist two other strategies that state policymakers should pursue. First, they should reallocate existing education funds to programs that produce larger impacts. The state should launch a program to systematically evaluate the impact of all state-supported education programs that aim to increase postsecondary outcomes. This is a large project, but a starting point should be all state-supported student financial aid programs. State policymakers should also systematically eliminate or reduce education funding that is not intended to improve measurable postsecondary student outcomes. These often represent special projects important to a local constituency but do not support the state's 60x30 goal.

This study identified two policies that produce measurable and meaningful impacts on postsecondary degree attainment: TEXAS Grants and dual credit. Unfortunately, both of these policies have been only moderately implemented. A reallocation of existing education funds should result in fully funding TEXAS Grants. Policymakers should also consider creating a new financial aid program to incentivize more high school students and their school districts to increase dual-credit participation and ensure quality.

This dual-credit grant program could be funded with existing general revenue that is reprogramed from less effective spending. Because dual-credit programs are subsidized by school districts and supported by low-cost community colleges, this program would be the most cost-efficient approach for increasing college access and completion. It would also produce the additional benefit of minimizing time out of the workforce, as dual-credit students complete college within a shorter timespan than their counterparts who do not earn dual credit.

To illustrate the efficiency of a dual-credit grant program, consider the use of $100 million in state funding. A grant program of $100 million pays for the tuition and fees of approximately 22,862 students earning 15 credit hours at the average Texas public university[25]. This money could alternatively pay for approximately 105,263 high school students earning 15 credit hours before they graduate from high school[26].

In addition to creating this dual-credit grant program, the state should work with school districts and institutions of higher education to identify solutions for overcoming barriers to dual-credit participation. These barriers include the decline in college-ready student identification due to a loss of state-mandated high school exams, which were previously used to qualify students as college-ready; professional development of dual-credit teachers in high-demand core academic subjects; and the transfer of core academic dual-credit subjects to degree programs.

Second, state policymakers should develop new financial models for helping financially-constrained, but college-ready, students access and complete college. The state should explore any and all mechanisms to innovate the financing of higher education. Two examples include income-sharing agreements (ISA's) and a state version of Loans for Educational Opportunity (Dynarski & Kreisman, 2013).

ISA's are agreements between student borrowers and lenders. In exchange for financial aid to finance postsecondary education, students agree to share a fixed percent of their future earnings with the lenders for a fixed set of years after they leave college. Advances are based on a student's expected future earnings. Students completing degrees

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[25] This calculation was based on the fall 2016 average tuition and fees of Texas public universities of $4,374 for a full-time student enrolled in 15 SCH.

[26] This calculation was based on cost figures provided by Alamo Colleges, which set the cost of a dual-credit classroom of 15 students earning 3 SCH at $2,800. After multiplying by five and rounding up, the cost per dual-credit student earning 15 SCH equals $950.

with higher expected earnings, such as engineering majors, can receive more of an advance. Students who earn below their expected earnings repay less than expected. Students who earn more than their expected earnings repay more than expected, though some agreements cap the total repayment amount.

The Texas legislature should pass legislation creating the framework for Texas universities to engage in providing ISA's. It could also create and fund a pilot project to evaluate the effectiveness of this financial model.

The authors of the Loans for Educational Opportunity (LEO) program believe that US students are not experiencing a student debt problem but a repayment problem. Part of their policy solution is to create a single loan program that would be repaid through the US government's social security payroll tax deduction system. Students with student debt would have their payroll deducted each month by a low fixed percent for up to 25 years or until their loan was repaid. If a student became unemployed, their loan repayment deductions would be automatically suspended and would automatically resume upon reemployment.

The Texas legislature should consider adopting aspects of the LEO program to improve the state's existing college loan programs. Important improvements include subsidizing the interest payment, simplifying the application process, and authorizing the Texas Workforce Commission to use the state payroll deduction system to automatically collect loan repayments for students employed in Texas.

In conclusion, state policymakers have opportunities to make targeted investments, advance systemic innovations, and create new finance models that reduce the financial constraints that prevent college-ready students from earning a postsecondary degree in a timely fashion.

Appendix A

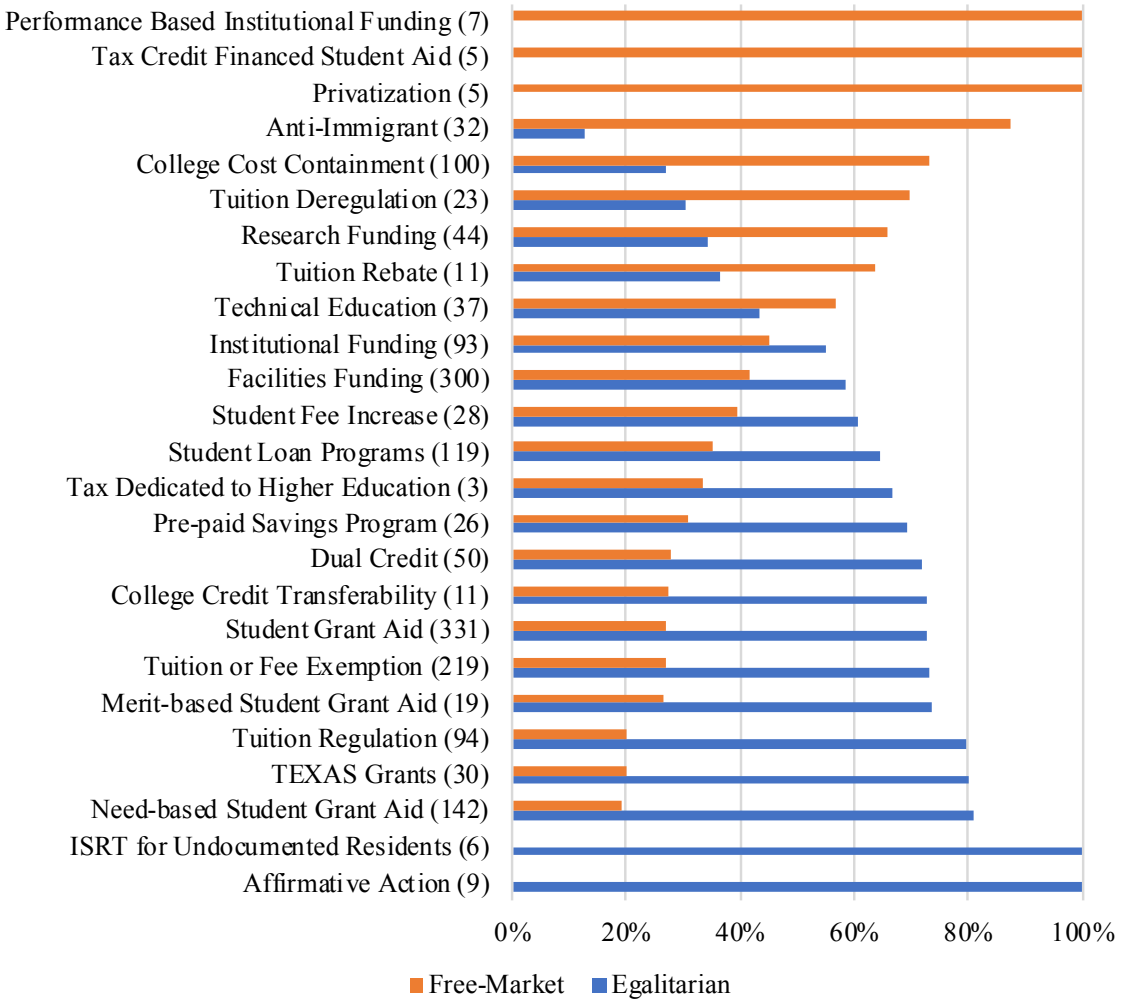
Table A1. Truncated Regression Results Testing Party Polarization

	Mean	SE	N	Prob > F
Democrat	-1.2	0.018 ***	725	0.000

Note: The dependent variable is a liberal-conservative score derived from non-lopsided roll call votes and produced using a Bayesian estimation procedure developed by Stanford University professor Simon Jackman.

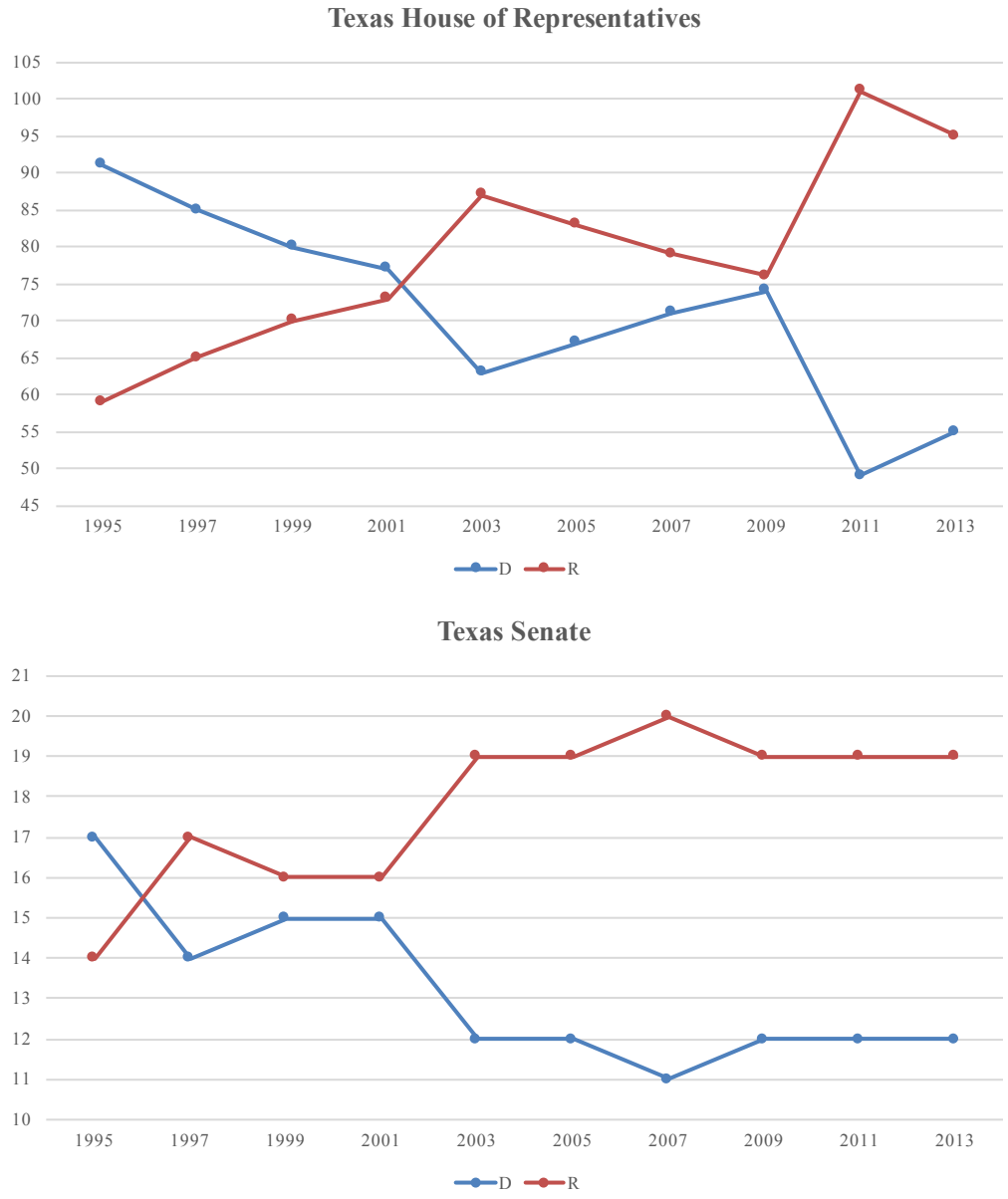
The p-values thresholds are represented at the following levels: < .1 +, < .05 *, < .01 **, < .001 ***

Figure A1. Percent of Higher Education Finance Bills by Coalition of Primary Author & by Topic (Frequency), Pooled Across 1995 to 2013 Legislatures



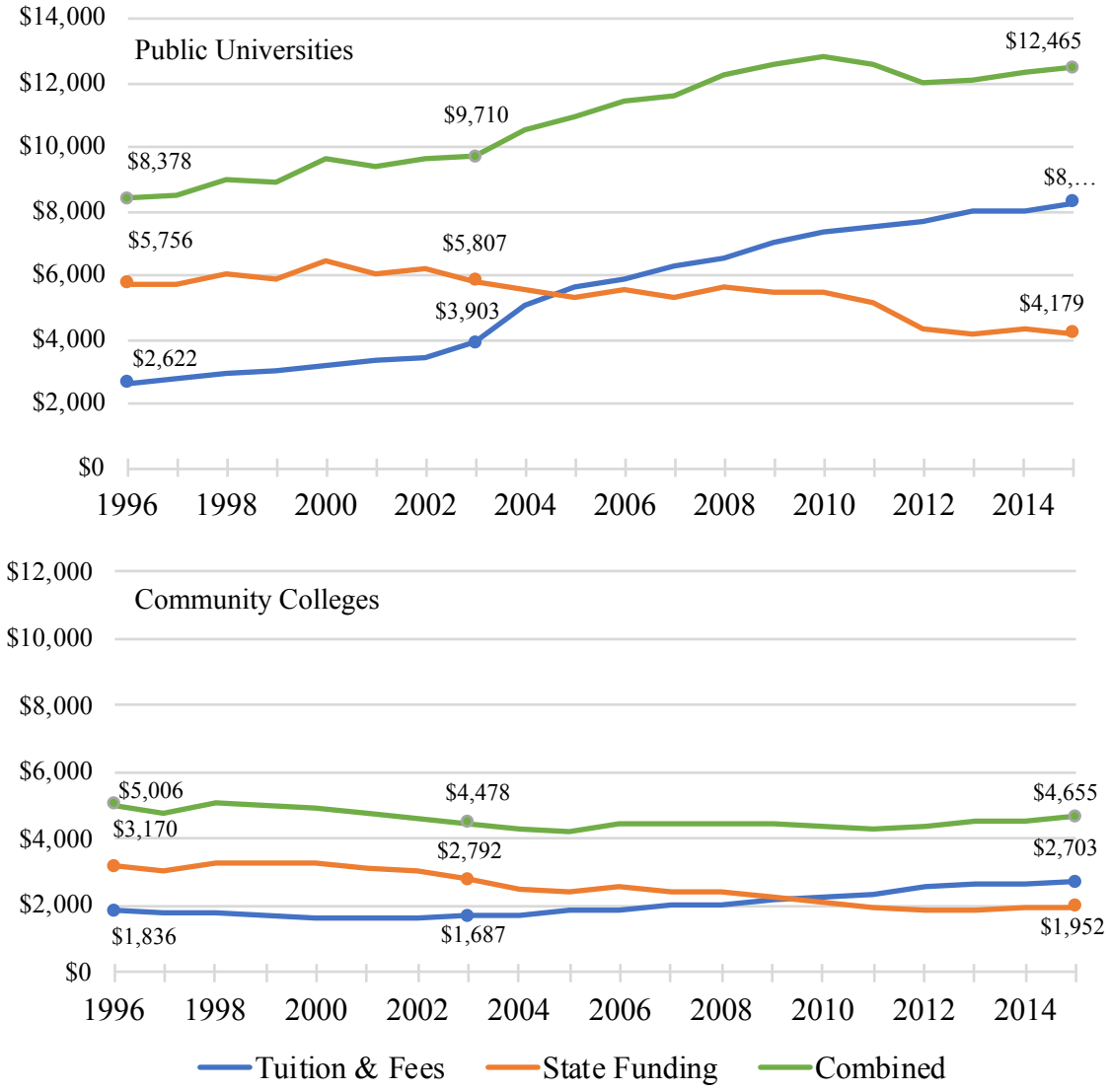
Note: A count of bills with a given topic is stated with the parenthesis next to the topic name. During the study period, 1995 to 2013, Democrats, the party of legislators who belong to the Egalitarian Coalition, represented 46.6 percent of all legislators, while Republicans, the party of legislators who belong to the Free-Market Coalition, represented 53.4 percent. All topics represent bills that promote the given topic unless otherwise stated. ISRT stands for in-state resident tuition. Privatization represents any bill that includes an aspect of privatization. Grant aid includes merit-based, need-based, and other types.

Figure A2. Party Composition, 74th to 83rd Texas Legislatures, (1995 to 2014)



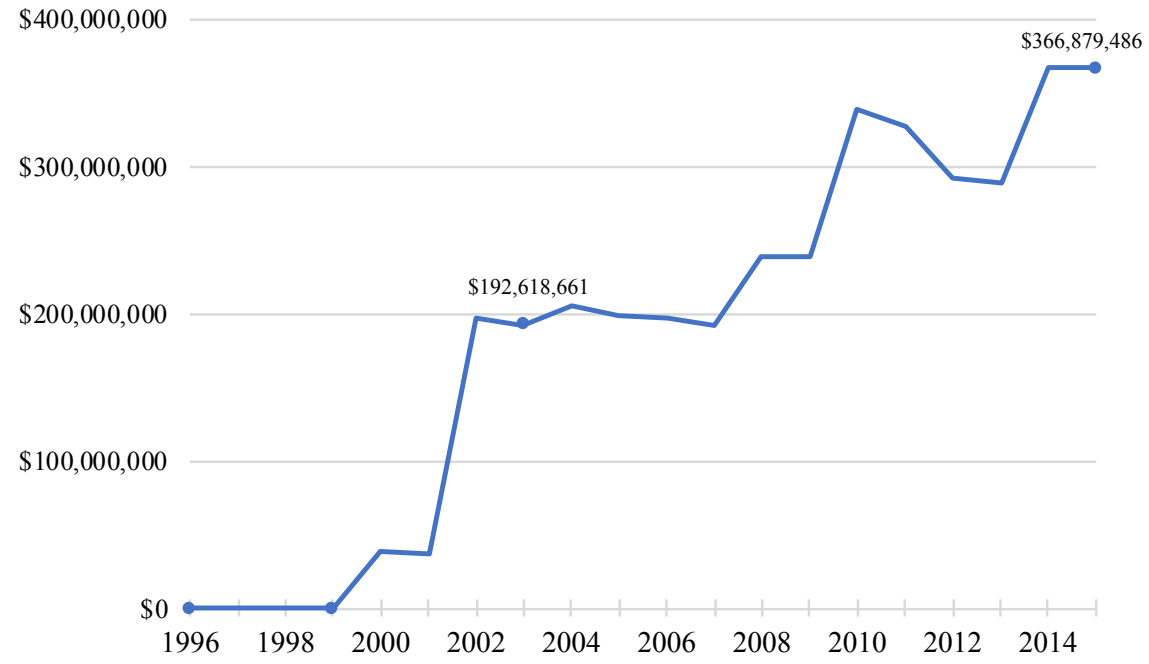
Source: The Texas Legislative Reference Library

Figure A3. Average Annual Tuition and Fees and State Institutional Funding per Full-Time Equivalent Student (2016 Real Dollars)



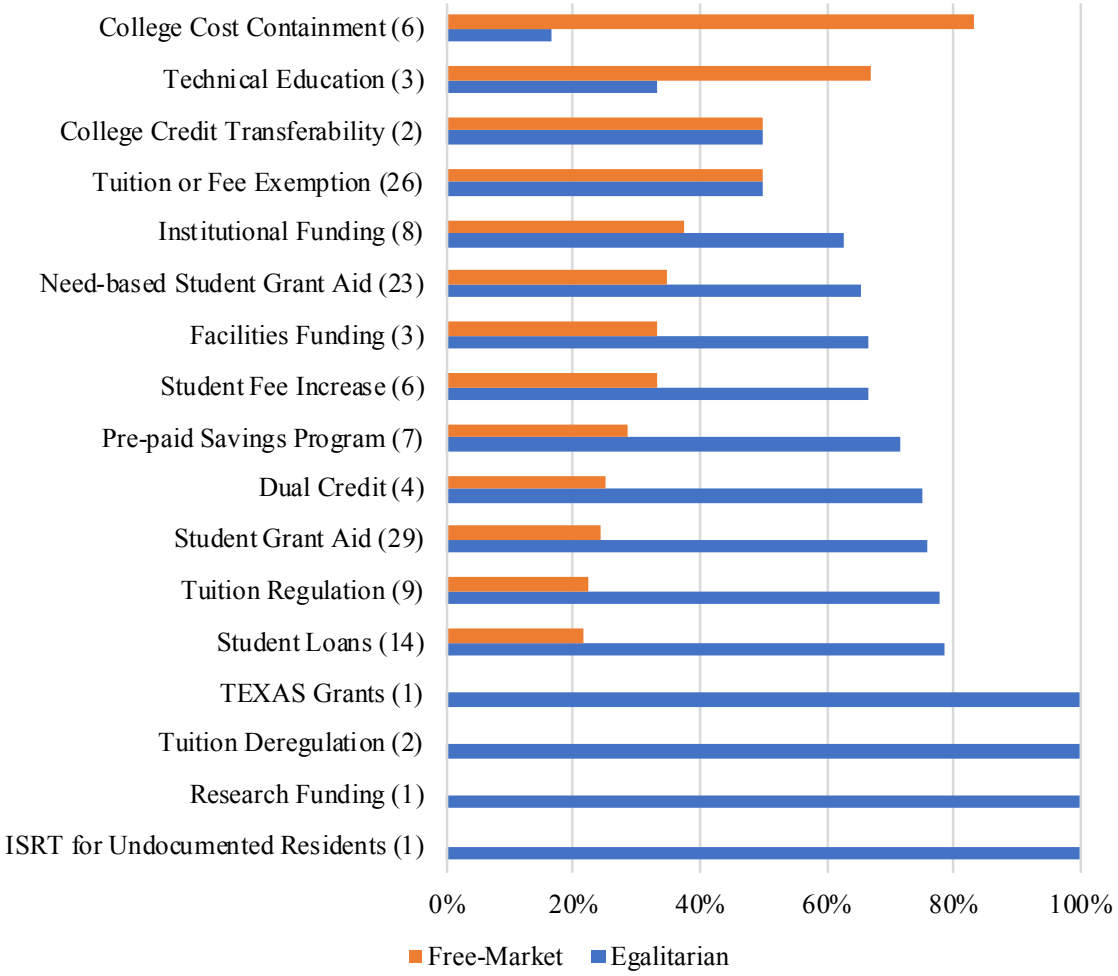
Note: The combined data series does not include revenue other than state institutional fund and tuition and fees. State institutional funding does not include TEXAS grant funding or any other student financial aid. Tuition and fees represent the published cost of tuition and mandatory fees for a student enrolled in 15 semester credit hours. It does not include discounts for student financial aid.

Figure A4. TEXAS Grant Allocation (2016 Real Dollars)



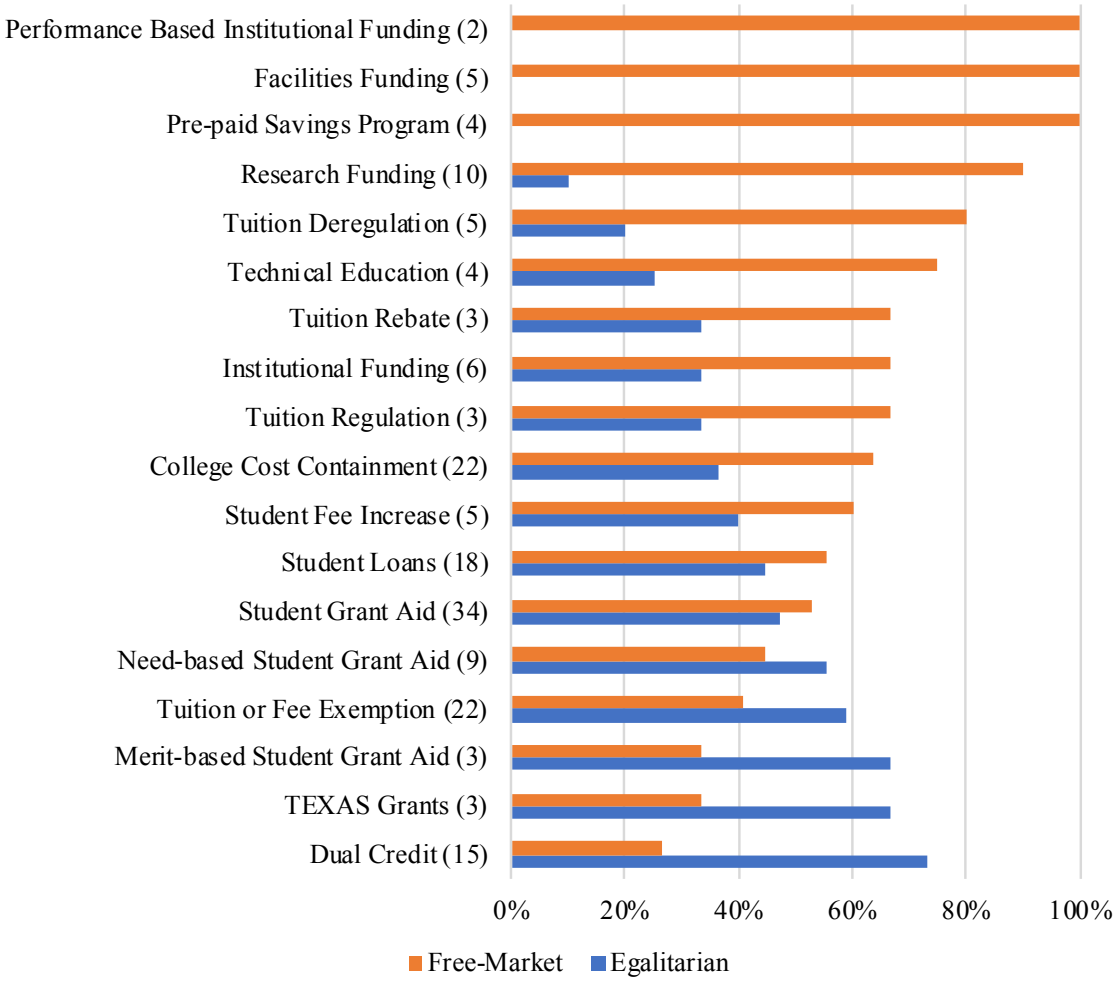
Source: Figures are sourced from general appropriation bills and are expressed in 2016 real dollars.

Figure A5. Percent of Higher Education Finance Bills that Passed by Coalition of Primary Author & by Topic (Frequency), Pooled Across 1995 to 2001 Legislatures



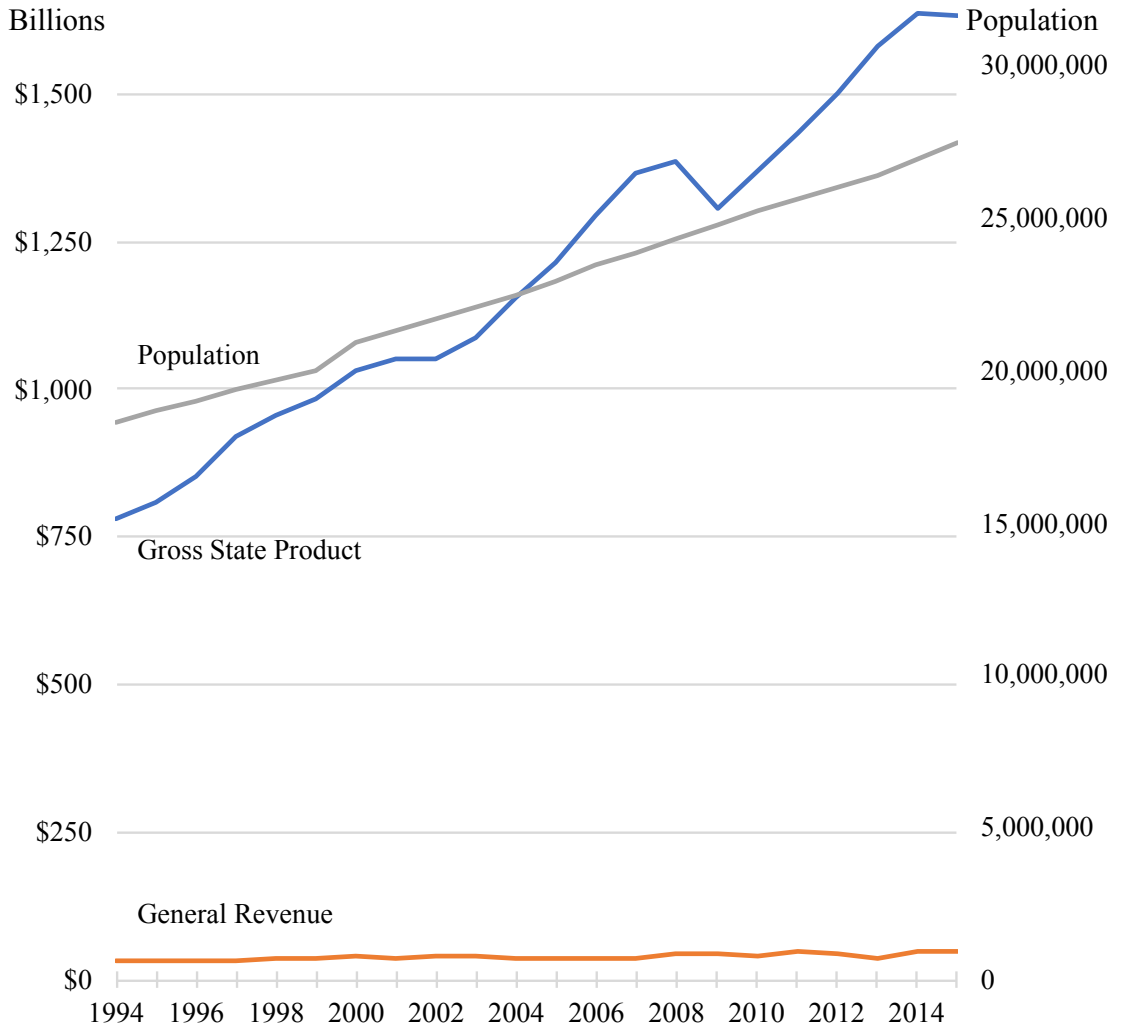
Note: A count of bills with a given topic is stated with the parenthesis next to the topic name. During the study period, 1995 to 2001, Democrats, the party of legislators who belong to the Egalitarian Coalition, represented 54 percent of all legislators, while Republicans, the party of legislators who belong to the Free-Market Coalition, represented 46 percent. All topics represent bills that promote the given topic unless otherwise stated. ISRT stands for in-state resident tuition. Privatization represents any bill that includes an aspect of privatization. Grant aid includes merit-based, need-based, and other types.

Figure A6. Percent of Higher Education Finance Bills that Passed by Coalition of Primary Author & by Topic (Frequency), Pooled Across 2003 to 2013 Legislatures



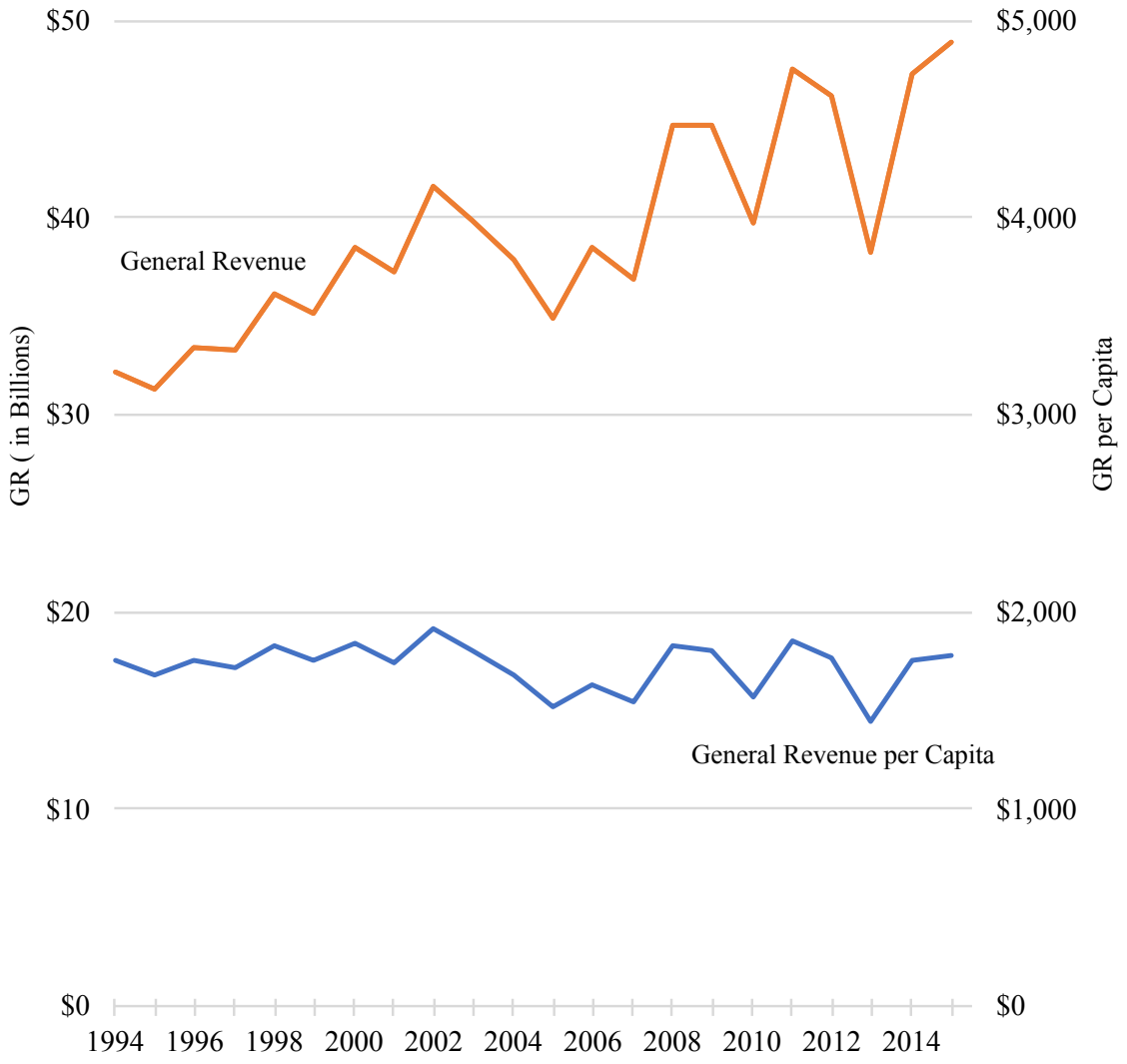
Note: A count of bills with a given topic is stated with the parenthesis next to the topic name. During the study period, 2003 to 2013, Democrats, the party of legislators who belong to the Egalitarian Coalition, represented 41 percent of all legislators, while Republicans, the party of legislators who belong to the Free-Market Coalition, represented 59 percent. All topics represent bills that promote the given topic unless otherwise stated. ISRT stands for in-state resident tuition. Privatization represents any bill that includes an aspect of privatization. Grant aid includes merit-based, need-based, and other types.

Figure A7.
Texas Population, Gross Domestic Product, & State General Revenue, 1997 to 2015



Source: Population figures provided by Texas State Library. Gross State Product was retrieved from www.bea.gov. General Revenue was retrieved from appropriation bills. Dollars in 2016 real dollars.

Figure A8.
Texas State General Revenue (GR) & GR per Capita, 1997 to 2015



Note: The left axis represents Texas state general revenue (GR) in billions. The right axis represents per-capita GR in dollars. Population figures provided by Texas State Library. General Revenue was retrieved from appropriation legislation. Dollars in 2016 Real dollars.

Appendix B

Table B1 summarizes the eight published studies that used experimental or quasi-experimental methods for estimating student grant aid effects on college graduation rates (Alon, 2005; Alon, 2007; Bettinger, Gurantz, Kawano, & Sacerdote, 2016; Castleman & Long, 2013; Dynarski, 2008; Goldrick-Rab, Kelchen, Harris, & Bensen, 2016; Scott-Clayton, 2011; Scott-Clayton & Zafar, 2016). Two of the eight were by authors who revised their estimates with more data. As summarized in Table B1, using the six unduplicated studies, I found that weighted average grant aid of $5,705 increased college completion by 2.72 percentage points. The weighted average timeframe used to measure college completion was approximately 11 years. Overall, for every $1,000 of grant aid, bachelor's degree completion increased by 0.46 percentage points based on a weighted average of effect sizes and grant aid.

I produced these findings by using a fixed-effects meta-analysis model that weighed each study by the inverse of their estimated variance. Studies varied by grant aid amount, time to completion studied, location, eligibility requirements, and how they define treatment effects (treatment-on-treated versus intent-to-treat effects). Consequently, I found heterogeneity to be statistically significant. Therefore, the meta-analysis' effect size should be interpreted as an average of different grant programs already evaluated and can serve as a useful benchmark for the findings of this study.

Table B1. Summary of Existing Grant Aid Impact Studies and Results of a Fixed Effects Meta-Analysis

	Meta-Analysis			Grant Program Design					
Study	Effect Size	SE	% Weight	Avg Annual Grant Amount (Nominal dollars)	Avg Annual Grant Amount (2016 dollars)	Grad Rate Term	Type	Site	Latest Cohort Studied
Alon 2007	1.5	2.40	2.32	$1,000	$1,936	6	TOT	USA	1989
Bettinger et al 2016	2.6	0.90	16.51	$9,000	$13,248	15	ITT	California	1998
Bettinger et al 2016	4.6	1.40	6.82	$9,000	$13,248	15	ITT	California	1998
Cattleman Long 2013	5.2	2.40	2.32	$1,300	$1,812	7	ITT	Florida	2000
Dynarski 2008	2.52	0.44	69.09	$2,500	$3,825	10	ITT	Georgia, Ark.	1996
Goldrick-Rab 2016	4.2	3.30	1.23	$3,500	$3,903	4	ITT	Wisconson	2008
Scott-Clayton Zafar 2016	1.9	2.80	1.71	$2,500	$3,260	10	TOT	W. Virgina	2003
Weighted average	2.72				$5,924	10.9			
Weighted average per $1000	0.46								

Note: This table summarizes the results of a fixed effects meta-analysis and describes the studies included in the analysis. The overall annual grant amount and graduation rate represented weighted averages of the original studies. TOT indicates a study estimated treatment-on-the-treated effect sizes. ITT indicates the study estimated intent-to-treat effect sizes. Studies that are repeated offered multiple effect size estimates using either different study populations or methodologies.

Table B2. Descriptive Statistics of Pretreatment Covariates of Students Who Meet All Eligibility Criteria Other Than EFC

	Unrestricted Sample: EFC >= $0 (N=358,226)		Restricted Sample: $2,600 < EFC < $5,400 (N=38,571)	
Variable	Mean	SD	Mean	SD
Age	18.02	0.32	18.01	0.31
Female	0.57		0.58	
Black	0.03		0.03	
Hispanic	0.10		0.08	
White	0.84		0.86	
Asian	0.03		0.03	
Other	0.004		0.004	
Immigrant	0.00		0.00	
First-generation college student	0.36		0.39	
Dual credits earned	0.89	1.73	0.87	1.70
Advanced Placement credits earned	2.69	2.77	2.61	2.69
Top 10% high school rank	0.32		0.32	
Top 25% high school rank	0.59		0.59	
SAT Score	1046	177	1035	167
High school distinguished diploma	0.30		0.28	
High school recommended diploma	0.70		0.72	
Other grants received in year one	4675	4404	4353	3950
Work-study aid in year one	86	451	126	533
Loan aid in year one	4218	5074	4335	4220
TEXAS grant eligible	0.52		0.57	
TEXAS grant awardee	0.40		0.44	
TEXAS grant awardee in year one	0.38		0.43	
TEXAS grant awardee in year two	0.24		0.27	
TEXAS grant awardee in year three	0.12		0.14	
TEXAS grant awardee in year four	0.08		0.10	
TEXAS grant awardee in year five	0.03		0.04	

Note: The distribution of students by estimated family contributon (EFC) peaks at zero, declines rapidly as EFC increases, and has a long right tail. The disproportionate share of low-income students to high-income students explains why the share of TEXAS grant eligible in the unrestricted populatoin is only slightly less than the restricted population.

Table B3.
Treatment-on-treated Effects of TEXAS Grants & Growth Rates Relative to Expected Control Group Outcomes

	TOT Effect Size				Control Group			
Student Outcomes	Mean	SE		Relative Growth Rate	Mean	SD	Bandwidth +/- $4,000 EFC	N
Other Grant Aid in Year 1	-631.196	262.066	*	-12.8%	4927.33	14802.99	1,242	24,709
Work-Study Aid in Year 1	-106.911	45.054	*	-46.5%	229.72	369.07	1,248	24,808
Loan Aid in Year 1	-2493.118	286.915	*	-40.5%	6154.32	10252.79	1,013	24,808
Persist to Year 2	-0.009	0.024		-1.0%	0.86	1.29	890	17,560
Persist to Year 3	0.025	0.021		2.9%	0.87	1.20	1,083	18,788
Persist to Year 4	0.019	0.019		2.1%	0.89	1.03	1,180	18,514
Continuous Enrollment	0.054	0.029	+	8.2%	0.66	0.01	825	16,301
SCH Cumm in Year 1	-0.043	0.236		-0.2%	28.65	0.64	1,240	24,652
SCH Cumm in Year 2	0.975	0.818		1.9%	51.95	2.87	892	17,577
SCH Cumm in Year 3	2.849	1.448	*	3.9%	73.00	6.17	859	16,973
SCH Cumm in Year 4	5.208	2.03	*	5.7%	91.21	9.80	913	17,993
Bachelor's Grad Rate 4-Yrs	0.058	0.032	+	22.3%	0.26	0.01	892	17,600
Bachelor's Grad Rate 5-Yrs	0.096	0.031	**	20.8%	0.46	0.01	977	16,697
Bachelor's Grad Rate 6-Yrs	0.067	0.031	*	12.1%	0.56	0.01	1,227	17,767
Bachelor's Grad Rate 7-Yrs	0.061	0.026	*	10.3%	0.60	0.01	2,129	26,029
Bachelor's Grad Rate 8-Yrs	0.031	0.036		4.9%	0.64	0.01	1,637	15,381
Total Debt	-6499.323	1795.333	***	-23.7%	27373.47	160339.73	935	18,481
Graduate Degree Grad Rate 6-Yrs	0.014	0.010		49.2%	0.03	0.00	1,188	17,161
Graduate Degree Grad Rate 7-Yrs	0.004	0.016		7.6%	0.06	0.00	1,524	18,297
Graduate Degree Grad Rate 8-Yrs	0.020	0.017		24.8%	0.08	0.00	1,301	12,076
Graduate Degree Grad Rate 9-Yrs	0.046	0.024	+	51.1%	0.09	0.00	864	5,954
Graduate Degree Grad Rate 10-Yrs	0.063	0.027	*	64.8%	0.10	0.00	1,706	7,755

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Table B3 Continued.
Treatment-on-treated Effects of TEXAS Grants & Growth Rates Relative to Expected Control Group Outcomes

	TOT Effect Size			Control Group			
Student Outcomes	Mean	SE	Relative Growth Rate	Mean	SD	Bandwidth +/- $4,000 EFC	N
Earnings Q4Q1 Year 1	-401.748	148.967 **	-30.4%	1322.37	10662.91	1,185	13,578
Earnings Q4Q1 Year 2	-449.976	190.291 *	-18.2%	2467.83	14986.13	1,297	18,565
Earnings Q4Q1 Year 3	-82.463	316.17	-2.5%	3252.89	16846.42	854	11,754
Earnings Q4Q1 Year 4	-22.823	303.454	-0.5%	4153.49	18357.45	1,078	14,595
Employed Year 1	-0.007	0.026	-1.1%	0.69	0.01	996	19,674
Employed Year 2	-0.025	0.022	-3.3%	0.75	0.01	1,023	20,211
Employed Year 3	0.014	0.026	1.8%	0.75	0.01	1,011	19,966
Employed Year 4	-0.020	0.021	-2.5%	0.78	0.01	1,232	24,516
Employed Year 5	-0.005	0.021	-0.6%	0.79	0.01	1,372	27,346
Employed Year 6	0.022	0.020	2.8%	0.79	0.01	1,589	27,648
Employed Year 7	0.026	0.025	3.3%	0.79	0.01	1,473	21,406
Employed Year 8	0.028	0.022	3.6%	0.78	0.01	1,846	22,322
Employed Year 9	0.045	0.028	5.9%	0.77	0.01	2,068	19,682
Employed Year 10	0.016	0.045	2.1%	0.77	0.01	1,136	7,787
Earnings Year 1	-617.281	330.498 +	-11.2%	5526.54	15302.01	1,636	22,638
Earnings Year 2	-646.930	465.386	-8.2%	7914.81	23213.78	1,488	22,032
Earnings Year 3	-862.503	567.489	-8.6%	10052.01	28713.28	1,307	19,513
Earnings Year 4	815.247	709.968	6.9%	11901.04	35818.47	1,108	16,787
Earnings Year 5	1960.679	1163.509 +	10.2%	19272.21	60884.63	1,179	18,536
Earnings Year 6	1563.040	1212.417	5.9%	26308.34	71320.61	1,533	21,239
Earnings Year 7	1237.027	1541.532	3.9%	31865.62	107220.09	1,440	16,633
Earnings Year 8	557.740	1824.990	1.5%	36833.23	135966.58	1,498	14,175
Earnings Year 9	1642.411	2255.732	4.0%	40774.69	146929.27	1,577	11,616
Earnings Year 10	2320.994	3231.683	5.2%	44802.86	249565.81	1,346	7,195

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Table B4. Robustness Check of Effect Size Estimate by Varying Bandwidths

Bandwidth multiplied by following scales	0.5	0.6	0.7	0.8	0.9	**1**	1.1	1.2	1.3	1.4	1.5
Other Grant Aid in Year 1											
TOT	-435	-526	-528	-734	-744	**-631**	-627	-614	-632	-653	-676
SE	358	316 +	315 +	286 *	277 **	**262** *	240 **	233 **	218 **	206 **	192 ***
N	12189	14685	17155	19598	22115	**24709**	27245	29846	32558	35165	37766
Work-Study Aid in Year 1											
TOT	-72	-86	-102	-111	-111	**-107**	-123	-122	-110	-114	-128
SE	64	59	56 +	48 *	47 *	**45** *	43 **	40 **	38 **	35 **	34 ***
N	12223	14768	17231	19714	22191	**24808**	27367	30008	32703	35307	37936
Loan Aid in Year 1											
TOT	-2744	-2511	-2421	-2309	-2477	**-2493**	-2339	-2403	-2206	-2233	-2180
SE	380 ***	360 ***	331 ***	331 ***	294 ***	**287** ***	283 ***	273 ***	272 ***	265 ***	259 ***
N	9903	11913	13909	16018	17969	**20023**	22044	24124	26217	28334	30483
Persist to Year 2											
TOT	-0.051	-0.039	-0.018	-0.026	-0.029	**-0.009**	-0.011	-0.008	-0.010	0.000	-0.006
SE	0.035	0.033	0.032	0.03	0.028	**0.024**	0.023	0.021	0.02	0.018	0.018
N	8773	10480	12223	13981	15841	**17560**	19316	21123	22893	24791	26610
Persist to Year 3											
TOT	0.067	0.067	0.054	0.039	0.039	**0.025**	0.023	0.017	0.008	0.004	0.008
SE	0.027 *	0.027 *	0.025 *	0.024 +	0.022 +	**0.021**	0.019	0.02	0.019	0.019	0.019
N	9321	11180	13073	14996	16855	**18788**	20696	22689	24670	26684	28762
Persist to Year 4											
TOT	0.045	0.046	0.061	0.046	0.036	**0.019**	0.016	0.013	0.015	0.016	0.009
SE	0.029	0.026	0.023	0.022	0.021	**0.019**	0.017	0.018	0.017	0.015	0.015
N	9144	11030	12975	14814	16658	**18514**	20459	22430	24429	26416	28375
Continuous Enrollment to Year 4											
TOT	0.033	0.041	0.062	0.056	0.056	**0.054**	0.062	0.052	0.035	0.024	0.019
SE	0.041	0.043	0.038	0.036	0.033 +	**0.029** +	0.028 *	0.026 *	0.023	0.022	0.022
N	8129	9689	11298	12925	14618	**16301**	17871	19508	21190	22842	24594
SCH Cumm in Year 1											
TOT	-0.1	0.0	-0.1	0.0	-0.1	**0.0**	0.0	0.0	0.1	0.2	0.2
SE	0.3	0.3	0.3	0.3	0.3	**0.2**	0.2	0.2	0.2	0.2	0.2
N	12146	14635	17115	19553	22059	**24652**	27184	29781	32481	35081	37661
SCH Cumm in Year 2											
TOT	0.0	0.7	1.1	0.8	0.3	**1.0**	1.0	1.0	0.5	0.8	0.6
SE	1.4	1.3	1.1	1.0	1.0	**0.8**	0.8	0.7	0.7	0.7	0.6
N	8773	10480	12248	14000	15858	**17577**	19341	21147	22939	24830	26653
SCH Cumm in Year 3											
TOT	2.3	2.2	3.5	2.9	2.3	**2.8**	3.0	2.8	1.8	1.8	1.4
SE	2.3	2.3	2.0 +	1.8	1.7	**1.4** *	1.3 *	1.3 *	1.2	1.1 +	1.1
N	8437	10076	11786	13487	15243	**16973**	18665	20359	22101	23861	25660
SCH Cumm in Year 4											
TOT	4.9	5.8	6.2	5.2	4.2	**5.2**	4.7	3.0	2.9	2.3	2.4
SE	3.2	2.9 +	2.8 *	2.5 *	2.3 +	**2.0** *	1.9 *	1.7 +	1.6 +	1.6	1.6
N	8989	10741	12513	14363	16238	**17993**	19811	21673	23511	25401	27286

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Table B4 Continued. Robustness Check of Effect Size Estimate by Varying Bandwidths

Bandwidth multiplied by following scales	0.5	0.6	0.7	0.8	0.9	**1**	1.1	1.2	1.3	1.4	1.5
Bachelor's Grad Rate 4-Yrs											
TOT	0.060	0.077	0.081	0.068	0.057	**0.058**	0.050	0.043	0.042	0.046	0.039
SE	0.044	0.042 +	0.038 *	0.035 +	0.034 +	**0.032** +	0.03 +	0.03	0.028	0.027 +	0.028
N	8790	10497	12248	14000	15871	**17600**	19356	21175	22939	24853	26677
Bachelor's Grad Rate 5-Yrs											
TOT	0.067	0.110	0.101	0.100	0.112	**0.096**	0.068	0.073	0.065	0.054	0.055
SE	0.046	0.038 **	0.034 **	0.034 **	0.032 ***	**0.031** **	0.027 *	0.027 **	0.027 *	0.027 +	0.028 *
N	8279	9911	11627	13358	15015	**16697**	18389	20091	21872	23627	25353
Bachelor's Grad Rate 6-Yrs											
TOT	0.111	0.107	0.101	0.089	0.057	**0.067**	0.056	0.050	0.054	0.052	0.051
SE	0.044 *	0.038 **	0.037 **	0.036 *	0.030 +	**0.031** *	0.032 +	0.030 +	0.029 +	0.027 *	0.026 *
N	8812	10575	12382	14131	15927	**17767**	19566	21379	23297	25169	26985
Bachelor's Grad Rate 7-Yrs											
TOT	0.044	0.041	0.033	0.044	0.052	**0.061**	0.070	0.056	0.052	0.044	0.045
SE	0.031	0.033	0.033	0.030	0.026 *	**0.026** *	0.025 **	0.024 *	0.023 *	0.023 +	0.022 *
N	12680	15218	17859	20578	23254	**26029**	28939	31903	34831	37970	41063
Bachelor's Grad Rate 8-Yrs											
TOT	0.111	0.083	0.050	0.053	0.033	**0.031**	0.044	0.044	0.054	0.063	0.063
SE	0.041 **	0.042 +	0.036	0.038	0.036	**0.036**	0.035	0.031	0.031 +	0.030 *	0.028 *
N	7645	9108	10599	12141	13763	**15381**	16964	18592	20287	22074	23863
Total Debt											
TOT	-6969	-6199	-5972	-5510	-6089	**-6499**	-6818	-6566	-6982	-6572	-6933
SE	2312 **	2241 **	2008 **	1921 **	1887 **	**1795** ***	1722 ***	1628 ***	1549 ***	1529 ***	1419 ***
N	9183	11001	12842	14768	16647	**18481**	20313	22191	24124	26046	28001
Graduate Degree Grad Rate 6-Yrs											
TOT	0.026	0.035	0.032	0.019	0.015	**0.014**	0.013	0.007	0.005	0.007	0.008
SE	0.017	0.015 *	0.014 *	0.013	0.012	**0.010**	0.010	0.009	0.010	0.009	0.009
N	8518	10231	12016	13722	15428	**17161**	18906	20689	22505	24362	26140
Graduate Degree Grad Rate 7-Yrs											
TOT	0.044	0.026	0.027	0.014	0.003	**0.004**	0.014	0.018	0.019	0.020	0.018
SE	0.021 *	0.018	0.017	0.015	0.015	**0.016**	0.015	0.013	0.012	0.012 +	0.013
N	9113	10915	12708	14558	16369	**18297**	20247	22129	24088	26069	28216
Graduate Degree Grad Rate 8-Yrs											
TOT	0.057	0.042	0.034	0.029	0.019	**0.020**	0.017	0.023	0.029	0.030	0.031
SE	0.023 *	0.019 *	0.021	0.018	0.015	**0.017**	0.016	0.018	0.019	0.017 +	0.016 +
N	6043	7271	8461	9660	10836	**12076**	13330	14628	15924	17184	18480
Graduate Degree Grad Rate 9-Yrs											
TOT	0.027	0.020	0.055	0.046	0.052	**0.046**	0.049	0.052	0.039	0.029	0.033
SE	0.030	0.022	0.022 *	0.027 +	0.025 *	**0.024** +	0.025 +	0.022 *	0.022 +	0.020	0.021
N	2997	3583	4164	4755	5353	**5954**	6550	7109	7696	8311	8915
Graduate Degree Grad Rate 10-Yrs											
TOT	0.059	0.061	0.052	0.046	0.058	**0.063**	0.059	0.052	0.043	0.035	0.030
SE	0.037	0.030 *	0.025 *	0.025 +	0.028 *	**0.027** *	0.024 *	0.021 *	0.020 *	0.020 +	0.020
N	3780	4521	5321	6089	6940	**7755**	8568	9421	10306	11230	12199

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Table B4 Continued. Robustness Check of Effect Size Estimate by Varying Bandwidths

Bandwidth multiplied by following scales	0.5	0.6	0.7	0.8	0.9	**1**	1.1	1.2	1.3	1.4	1.5
Earnings Q4Q1 Year 1											
TOT	-517	-423	-374	-324	-305	**-402**	-454	-370	-342	-338	-355
SE	225 *	202 *	194 +	164 *	152 *	**149** **	154 **	144 *	135 *	124 **	123 **
N	11591	13955	16406	18725	21073	**23495**	25941	28417	30924	33502	35947
Earnings Q4Q1 Year 2											
TOT	-234	-31	-119	-181	-289	**-450**	-375	-325	-343	-340	-339
SE	275	245	207	206	198	**190** *	189 *	191 +	170 *	172 *	158 *
N	12730	15353	17894	20472	23091	**25804**	28506	31258	34022	36756	39501
Earnings Q4Q1 Year 3											
TOT	-529	-477	-377	-236	-7	**-82**	-174	-156	-189	-244	-328
SE	484	419	405	395	363	**316**	292	284	275	269	259
N	8394	10023	11702	13401	15128	**16894**	18558	20250	21942	23681	25495
Earnings Q4Q1 Year 4											
TOT	-399	-255	-139	-132	12	**-23**	66	26	10	-37	-53
SE	471	471	409	368	329	**303**	288	293	284	307	293
N	10576	12694	14874	17024	19143	**21325**	23495	25735	27979	30257	32596
Employed Year 1											
TOT	-0.040	-0.019	0.007	0.004	-0.010	**-0.007**	0.007	0.003	-0.005	-0.004	-0.007
SE	0.046	0.038	0.032	0.031	0.029	**0.026**	0.026	0.024	0.024	0.023	0.022
N	9760	11702	13661	15735	17680	**19674**	21673	23681	25757	27864	29937
Employed Year 2											
TOT	-0.027	-0.036	-0.028	-0.007	-0.022	**-0.025**	-0.027	-0.011	-0.026	-0.026	-0.024
SE	0.040	0.031	0.030	0.026	0.025	**0.022**	0.021	0.021	0.020	0.020	0.021
N	9995	12055	14074	16177	18176	**20211**	22251	24432	26488	28637	30819
Employed Year 3											
TOT	0.053	0.042	0.032	0.041	0.029	**0.014**	0.009	0.013	0.007	0.005	0.000
SE	0.039	0.033	0.028	0.028	0.027	**0.026**	0.025	0.024	0.023	0.021	0.020
N	9886	11895	13872	15979	17928	**19966**	21965	24054	26136	28271	30420
Employed Year 4											
TOT	-0.030	-0.015	-0.018	-0.026	-0.028	**-0.020**	-0.015	-0.018	-0.018	-0.019	-0.010
SE	0.030	0.025	0.024	0.022	0.022	**0.021**	0.019	0.019	0.018	0.017	0.017
N	12083	14555	17024	19442	21928	**24516**	27031	29578	32276	34869	37441
Employed Year 5											
TOT	0.031	0.010	-0.005	-0.016	-0.009	**-0.005**	-0.005	-0.010	-0.008	0.003	-0.003
SE	0.030	0.028	0.026	0.025	0.023	**0.021**	0.020	0.019	0.019	0.018	0.018
N	13445	16276	18948	21707	24557	**27346**	30238	33195	36065	38985	42005
Employed Year 6											
TOT	0.053	0.040	0.028	0.021	0.024	**0.022**	0.023	0.022	0.013	0.009	0.013
SE	0.031 +	0.027	0.025	0.023	0.021	**0.020**	0.017	0.016	0.016	0.016	0.016
N	13581	16316	19038	21872	24717	**27648**	30513	33417	36447	39473	42528
Employed Year 7											
TOT	0.038	0.053	0.045	0.032	0.029	**0.026**	0.014	0.016	0.021	0.017	0.021
SE	0.037	0.033	0.033	0.028	0.027	**0.025**	0.023	0.023	0.022	0.022	0.022
N	10596	12746	14850	17002	19191	**21406**	23676	25929	28190	30539	32890
Employed Year 8											
TOT	0.037	0.016	0.021	0.030	0.027	**0.028**	0.024	0.018	0.020	0.010	0.008
SE	0.034	0.032	0.028	0.027	0.026	**0.022**	0.021	0.020	0.021	0.021	0.020
N	11032	13199	15405	17673	20061	**22322**	24761	27194	29743	32293	34831
Employed Year 9											
TOT	0.022	0.007	0.025	0.033	0.046	**0.045**	0.044	0.043	0.034	0.033	0.029
SE	0.039	0.034	0.032	0.033	0.028	**0.028**	0.028	0.026	0.025	0.024	0.021
N	9575	11515	13497	15550	17536	**19682**	21905	24171	26365	28741	31162
Employed Year 10											
TOT	0.017	0.046	0.042	0.038	0.025	**0.016**	0.030	0.041	0.050	0.035	0.043
SE	0.073	0.070	0.062	0.052	0.052	**0.045**	0.041	0.041	0.039	0.036	0.033
N	3918	4704	5498	6245	7012	**7787**	8591	9407	10257	11103	11929

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Table B4 Continued. Robustness Check of Effect Size Estimate by Varying Bandwidths

Bandwidth multiplied by following scales	0.5	0.6	0.7	0.8	0.9	**1**	1.1	1.2	1.3	1.4	1.5
Earnings Year 1											
TOT	-861	-831	-839	-1011	-869	**-617**	-802	-733	-556	-583	-520
SE	485 +	436 +	418 *	410 *	374 *	**330** +	313 *	293 *	270 *	241 *	228 *
N	11215	13378	15622	17899	20220	**22638**	24950	27385	29866	32330	34800
Earnings Year 2											
TOT	-108	-243	-369	-610	-704	**-647**	-520	-562	-538	-447	-428
SE	594	494	511	498	480	**465**	417	407	359	346	321
N	10947	13117	15239	17480	19745	**22032**	24424	26697	29048	31501	33891
Earnings Year 3											
TOT	-1050	-511	-451	-541	-645	**-863**	-814	-536	-650	-874	-765
SE	879	803	717	679	594	**567**	542	547	517	509 +	463 +
N	9705	11653	13578	15513	17494	**19513**	21537	23576	25665	27701	29823
Earnings Year 4											
TOT	495	509	387	501	804	**815**	572	424	440	562	344
SE	1073	949	899	805	741	**710**	643	654	642	655	608
N	8371	10026	11712	13401	15066	**16787**	18568	20305	22089	23868	25698
Earnings Year 5											
TOT	-203	462	843	935	1829	**1961**	1860	1513	1780	1596	1378
SE	1632	1528	1473	1351	1265	**1164** +	1034 +	999	1007 +	926 +	896
N	9177	11034	12946	14772	16648	**18536**	20469	22405	24411	26407	28349
Earnings Year 6											
TOT	1241	708	1696	1842	1102	**1563**	1717	1419	1413	1722	1781
SE	1906	1695	1540	1381	1304	**1212**	1131	1129	1112	1033 +	950 +
N	10473	12570	14702	16884	19066	**21239**	23488	25663	27954	30260	32641
Earnings Year 7											
TOT	894	1131	1499	1600	548	**1237**	1465	1362	1019	1249	1385
SE	2276	2075	2042	1840	1701	**1542**	1392	1329	1261	1258	1197
N	8258	9926	11583	13243	14940	**16633**	18371	20118	21808	23614	25442
Earnings Year 8											
TOT	827	1084	1764	1077	650	**558**	762	36	616	1046	1580
SE	2710	2355	2288	2100	1999	**1825**	1718	1617	1541	1544	1438
N	7121	8472	9888	11319	12738	**14175**	15651	17112	18626	20160	21802
Earnings Year 9											
TOT	-329	471	465	128	2328	**1642**	1905	2360	2683	3087	3398
SE	3068	2835	2440	2238	2252	**2256**	2164	2087	2217	2029	1907 +
N	5778	6944	8063	9214	10378	**11616**	12833	14060	15297	16616	17939
Earnings Year 10											
TOT	-299	2775	2592	3217	2216	**2321**	2600	2780	2370	2880	2596
SE	4683	3908	3962	3504	3462	**3232**	3054	3049	2826	2712	2935
N	3582	4311	5029	5733	6450	**7195**	7958	8718	9460	10215	11008

Note: TOT effect size represents the treatment-on-treated effect size produced by a regression discontinunity instrumental-variable methodology. The relative growth rate represents the TOT effect size divided by the expected control group outcome. Control group represents students near the $4,000 estimated family contribution cutpoint and within the optimized bandwidth. Effect size standard errors are clustered by cohort and university enrolled in freshmen year. Year refers to the year post college entry. SCH represents semester credit hours. Q4Q1 represents the time span between October to the following March.

P-value thresholds are represented at the following levels: < 0.001 ***, < 0.01 **, <0.05 *, < 0.1 + .

Figure B1. McCrary Test of Manipulation at the Cutoff Point

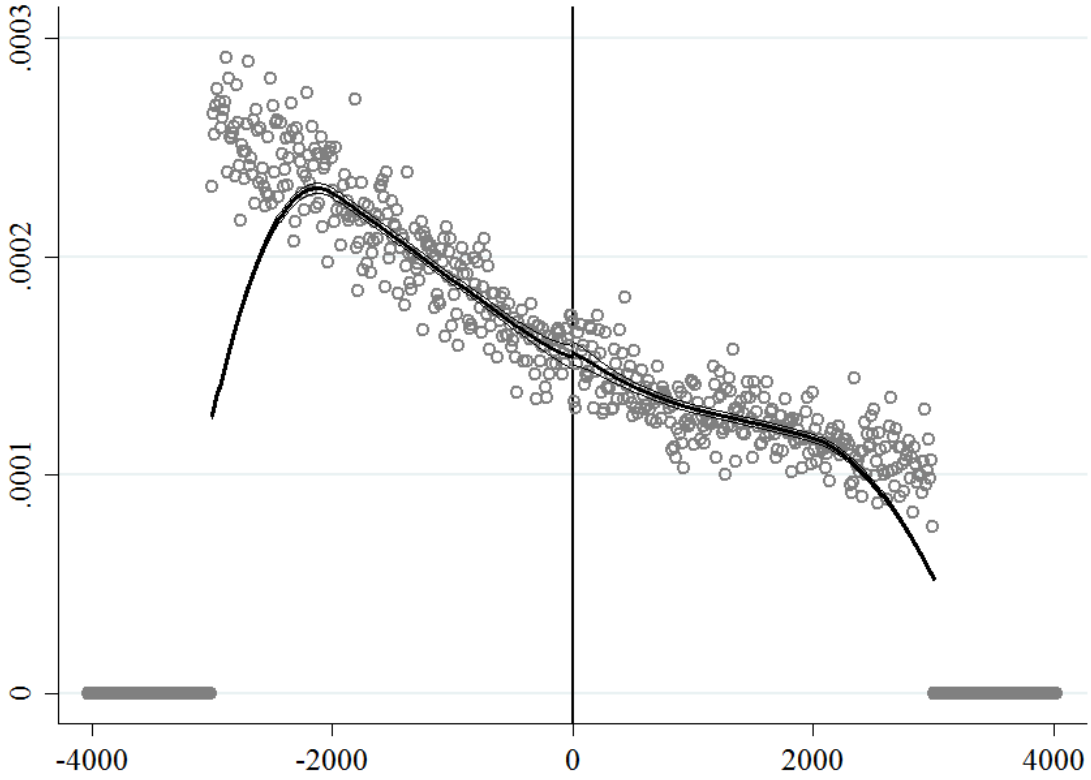


Figure B2. Requirements of Regresson Discontinuity
Distributions per $200 EFC Bins

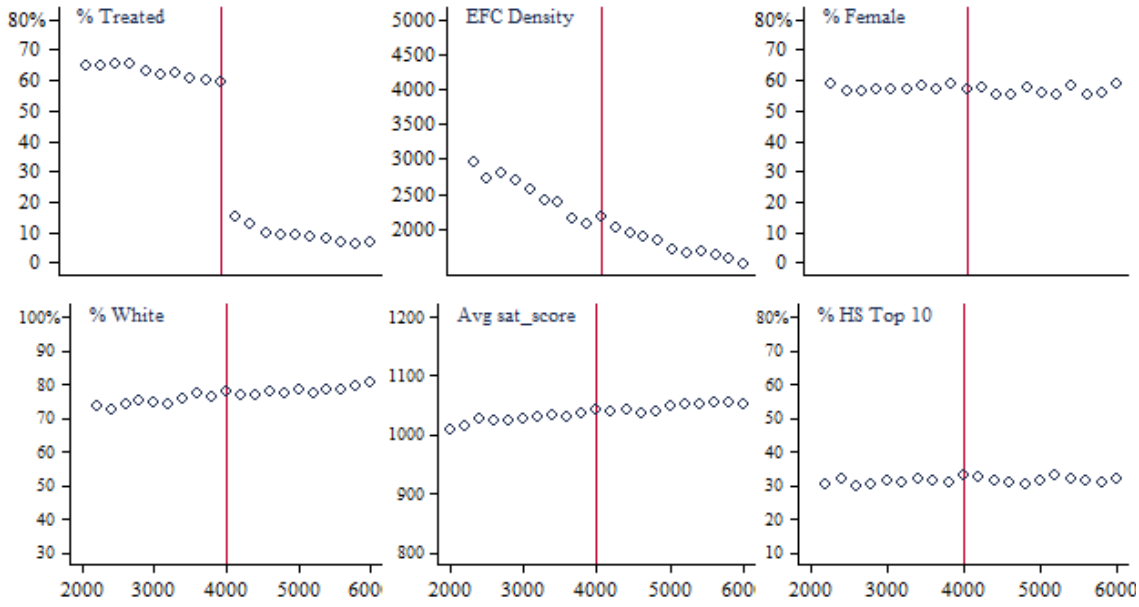


Figure B3. Average Bachelor's Degree Graduation Rate per $200 EFC Bins

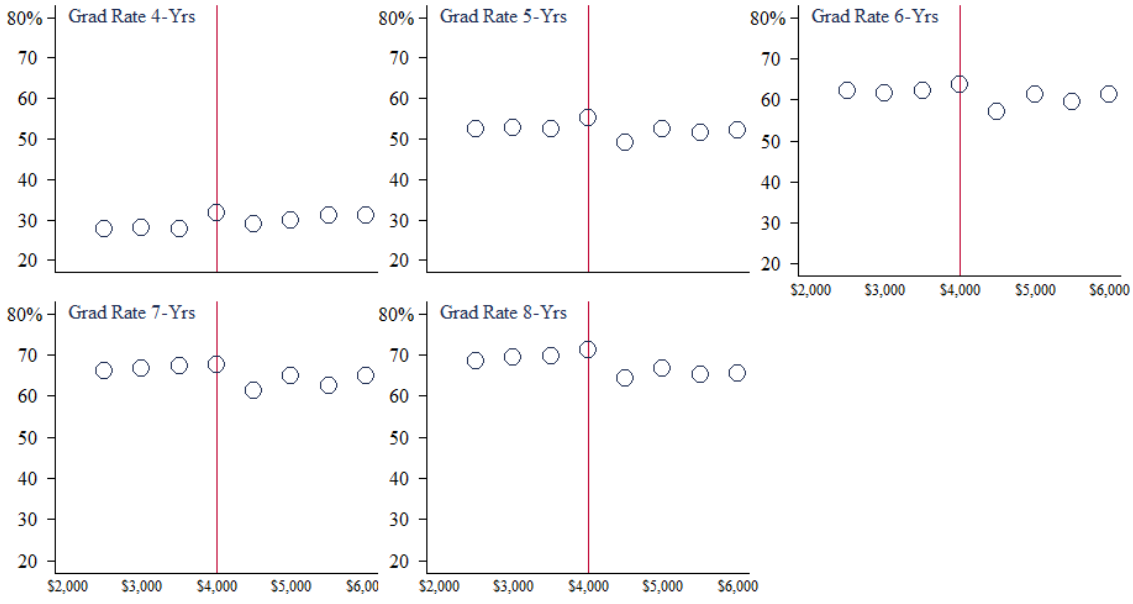
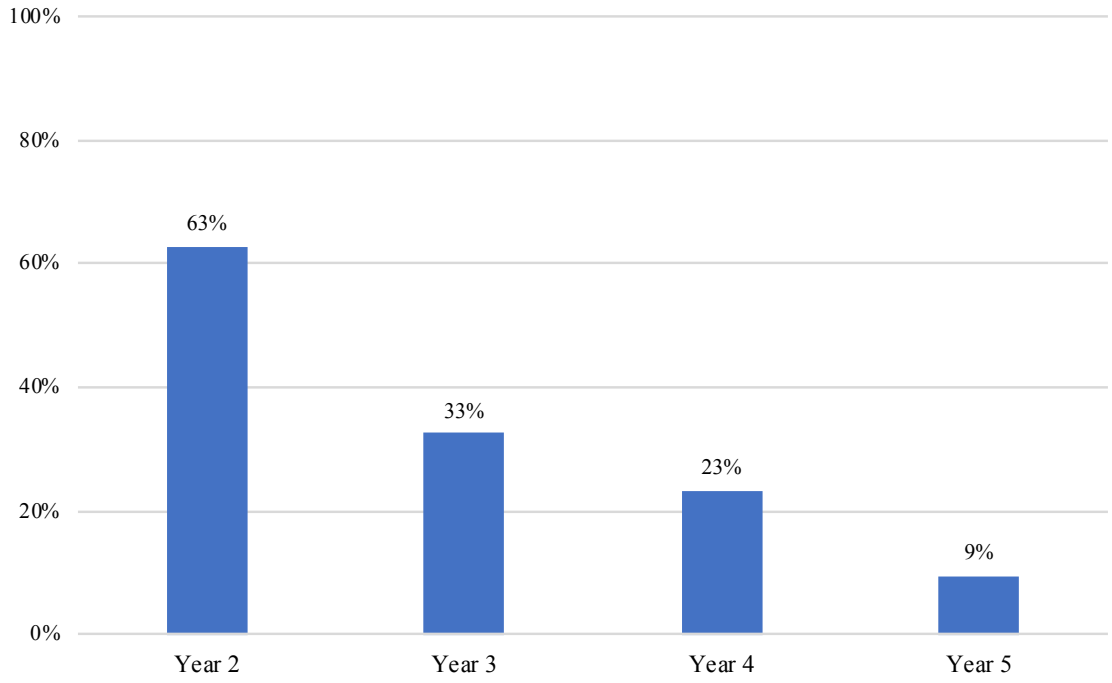


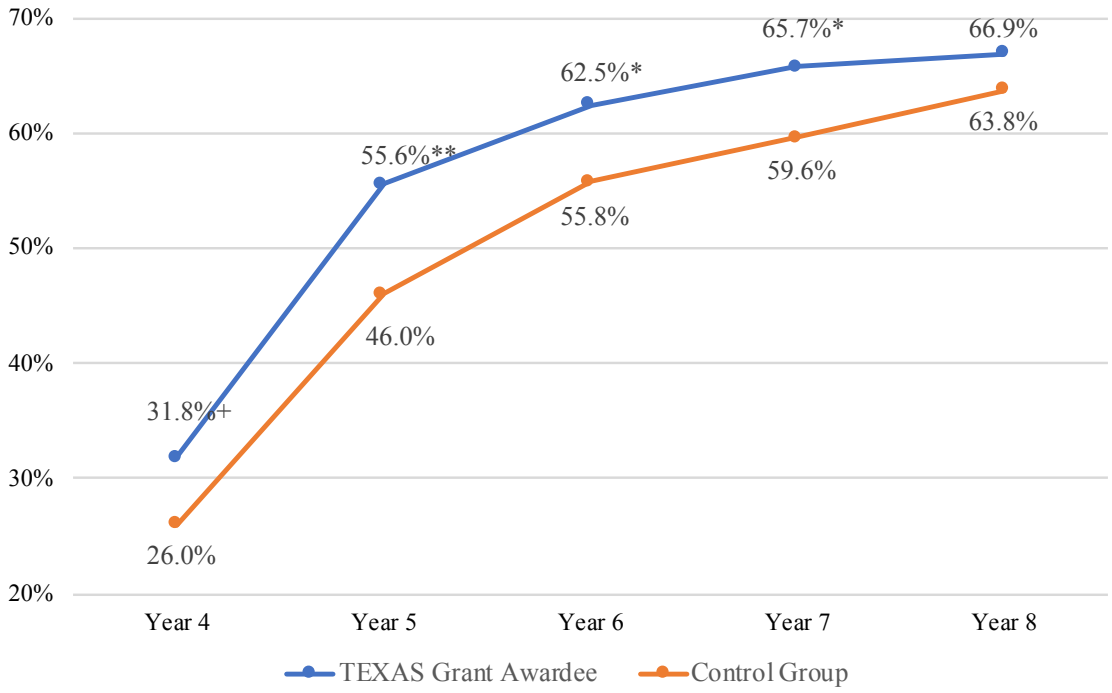
Figure B4. TEXAS Grant Effect on Bachelor's Degree Graduation Rates per $200 EFC Bins

Figure B5.
Percent of Initial TEXAS Grant Awardees who Renew Their Award in Years Following the First Year of College Entry



Note: Percent is based on the restricted study sample of students who entered college in the fall of 2004 to 2011, who have an Estimated Family Contribution between $2,600 and $5,400, and who meet all other TEXAS Grant eligibility criteria.

Figure B6.
Bachelor's Degree Graduation Rates by Time to Degree



Note: TOT effect size represents the treatment on the treated effect size produced by a regression discontinuity instrumental-variable method. Control group estimates represent expected graduation rates of students who do not receive a TEXAS grant. Year refers to the year since college entry.

P-value indicators represent statistical significance of effect sizes. The p-values thresholds are represented at the following levels: < .001 ***, < .01 **, < .05 *, <.1 +.

Appendix C

Table C1. The Frequency of Declines in Dual-Credit Participation by School Districts Across Eleven Cohorts of High School Students

Declines	Frequency	Percent
0	90	8%
1	82	7%
2	98	8%
3	213	18%
4	318	27%
5	253	22%
6	100	9%
7	19	2%
8	0	0%
9	0	0%
10	0	0%
Total	1173	100%

Note: This study followed eleven cohorts of Texas public high school students starting in the year they entered high school. The study period was from 2001 to 2011. The above table describes the frequency of declines in dual-credit participation across time by 1173 school districts in the study population. Eighty eight school districts experienced no declines, while one experienced eight declines.

Table C2. Descriptive Statistics of School Districts, Observantions pooled across 11 cohorts

	N	Mean	SD	Min	Max
White	12,021	0.57	0.30	0.00	1.00
Hispanic	12,021	0.31	0.29	0.00	1.00
Black	12,021	0.10	0.16	0.00	1.00
Asian	12,021	0.01	0.03	0.00	0.68
Other	12,021	0.01	0.02	0.00	0.34
Immigrant	12,021	0.00	0.01	0.00	0.86
Federal Reduced Lunch Participation	12,021	0.09	0.07	0.00	1.00
Federal Free Lunch Participation	12,021	0.37	0.21	0.00	1.00
Federal Food Assistance Participation	12,021	0.03	0.12	0.00	1.00
Reading 8th grade Z-score	12,021	-0.02	0.38	-4.15	2.55
Math 8th grade Z-score	12,021	-0.07	0.41	-3.80	2.72
Dual Credit Participation	12,021	0.18	0.17	0.00	1.00
AP Participation	12,021	0.48	0.58	0.00	8.14
Avg Math Dual Credit	12,021	0.05	0.11	0.00	1.97
Avg English Dual Credit	12,021	0.15	0.21	0.00	4.00
Avg Science Dual Credit	12,021	0.01	0.05	0.00	1.13
Avg Social Science Dual Credit	12,021	0.22	0.31	0.00	4.06
Avg Foreign Language Dual Credit	12,021	0.01	0.05	0.00	1.25
Avg Health Dual Credit	12,021	0.00	0.03	0.00	1.58
Avg Art Dual Credit	12,021	0.01	0.03	0.00	0.77
Avg Computer Science Dual Credit	12,021	0.00	0.02	0.00	0.81
Avg Other Dual Credit	12,021	0.00	0.01	0.00	0.39
Avg Master's-degreed-instructor Dual Credit	2,212	0.18	0.32	0.00	2.72
Avg Doctoral-degreed-instructor Dual Credit	2,212	0.01	0.05	0.00	1.06
Avg Face-to-face Dual Credit	2,212	0.62	0.80	0.00	6.14
Avg Blended Dual Credit	2,212	0.34	0.69	0.00	11.06
Avg Video Dual Credit	2,212	0.19	0.54	0.00	5.73
Avg Computer-based Dual Credit	2,212	0.00	0.02	0.00	0.64
Avg High-school-located Dual Credit	2,072	0.02	0.16	0.00	3.43
Avg Community-College-located Dual Credit	2,186	0.50	0.93	0.00	7.42
Avg University-located Dual Credit	2,212	0.37	0.77	0.00	11.67
Avg Other-located Dual Credit	2,212	0.28	0.52	0.00	6.60

Note: DC stands for Dual Credit. The drop in observations of variables describing instructors' highest degree held, location, and teaching mode represents a data limitation. The Texas Higher Education Coordinating Board began collecting these variables in 2012.

Table C3.
School-District Fixed Effects Regression Results Relating Changes in Dual Credit (DC) and Advanced Placement (AP) Participation to Student Outcomes

Student Outcomes	DC Coeff/(SE)	AP Coeff/(SE)	Baseline Estimate Mean/(SD)	Obs	ISD's	Rho
High School Grad Rate Year 4	0.066 (0.011)***	**0.123** **(0.011)***	0.729 (0.164)	12,021	1,173	0.93
Univ App Rate Year 5	0.100 (0.014)***	**0.160** **(0.015)***	0.260 (0.195)	12,021	1,173	0.90
Univ Admit Rate Year 5	0.096 (0.015)***	0.117 (0.013)***	0.221 (0.210)	12,021	1,173	0.89
Univ Enroll Rate Year 5	0.082 (0.010)***	0.079 (0.009)***	0.200 (0.146)	12,021	1,173	0.89
Comm College Enroll Rate Year 5	0.023 (0.012)+	**0.064** **(0.011)***	0.309 (0.176)	12,021	1,173	0.90
Associates Grad Rate Year 6	**0.021** **(0.004)***	-0.002 (0.004)	0.008 (0.049)	10,916	1,166	0.71
Associates Grad Rate Year 8	0.018 (0.005)***	0.005 (0.004)	0.033 (0.051)	8,708	1,140	0.81
Bachelor's Grad Rate Year 8	**0.051** **(0.005)***	0.029 (0.004)***	0.070 (0.055)	8,708	1,140	0.84
Bachelor's Grad Rate Year 10	0.056 (0.009)***	**0.097** **(0.009)***	0.155 (0.071)	6,535	1,122	0.88
Bachelor's Grad Rate Year 12	0.063 (0.014)***	**0.115** **(0.012)***	0.180 (0.083)	4,344	1,115	0.90
Graduate Degree Grad Rate Year 12	0.008 (0.004)*	**0.024** **(0.004)***	0.022 (0.021)	4,344	1,115	0.71
Graduate Degree Grad Rate Year 13	0.003 (0.004)	**0.029** **(0.006)***	0.028 (0.022)	3,250	1,107	0.76

Note: The above results were produced by a school-district fixed effects regression model using school district-level panel data with probability weights that equal a distrist's average student population as a percent of the total average statewide population of students. ISD's represents the number of unique school districts. Obs represents total number of pooled observations. Standard errors were clustered by school district. Dual credit (DC) and Advanced Placement (AP) represent the percent of students earning at least one DC and AP credit per cohort per school district, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. For all models, the hypothesis that coeifficients were jointly equal to zero could be rejected with a p-value less than 0.001. Bolded effects were statistically distinct from a majority of the other effect sizes based on a two-tailed t-test and a p-value of less than 0.05.

P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

Table C4.
School-District Fixed Effects Regression Results Relating Changes in Average Dual Credit (DC) and Advanced Placement (AP) Credit Earned in Quadratic Functional Form to Student Outcomes

	DC	DC X DC	AP	AP X AP	Constant			
Student Outcomes	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	**Obs**	**ISD's**	**Rho**
High School Grad Rate Year 4	0.0284	-0.0052	0.0468	-0.0098	0.6865	12,021	1,173	0.93
	(0.005)***	(0.001)***	(0.007)***	(0.001)***	(0.013)***			
Univ App Rate Year 5	0.0406	-0.0024	0.0474	-0.0049	0.2333	12,021	1,173	0.91
	(0.004)***	(0.001)*	(0.008)***	(0.002)**	(0.015)***			
Univ Admit Rate Year 5	0.0383	-0.0023	0.0289	-0.002	0.2216	12,021	1,173	0.90
	(0.005)***	(0.001)*	(0.008)***	(0.002)	(0.015)***			
Univ Enroll Rate Year 5	0.0342	-0.0015	0.0281	-0.0042	0.2216	12,021	1,173	0.90
	(0.004)***	(0.001)+	(0.005)***	(0.001)**	(0.011)***			
Comm College Enroll Rate Year 5	0.0022	-0.002	0.025	-0.0053	0.2918	12,021	1,173	0.90
	(0.004)	(0.001)+	(0.005)***	(0.001)***	(0.01)***			
Associates Grad Rate Year 6	0.0066	0.0041	0.001	-0.0006	0.0063	10,916	1,166	0.72
	(0.002)**	(0.001)***	(0.001)	(0.000)*	(0.003)*			
Associates Grad Rate Year 8	0.0049	0.0031	0.0038	-0.0015	0.0249	8,708	1,140	0.81
	(0.004)	(0.002)	(0.002)*	(0.000)**	(0.004)***			
Bachelor's Grad Rate Year 8	0.0196	0.0025	0.0108	-0.0009	0.0897	8,708	1,140	0.83
	(0.002)***	(0.001)+	(0.002)***	(0.001)	(0.005)***			
Bachelor's Grad Rate Year 10	0.0268	0.0035	0.0333	-0.0048	0.1765	6,535	1,122	0.88
	(0.005)***	(0.003)	(0.004)***	(0.001)***	(0.008)***			
Bachelor's Grad Rate Year 12	0.0364	0.002	0.043	-0.0085	0.1905	4,344	1,115	0.90
	(0.007)***	(0.004)	(0.007)***	(0.003)**	(0.009)***			
Graduate Degree Grad Rate Year 12	0.0058	0.0004	0.0111	-0.0019	0.0221	4,344	1,115	0.70
	(0.003)*	(0.002)	(0.002)***	(0.001)***	(0.003)***			
Graduate Degree Grad Rate Year 13	0.004	0.0009	0.0131	-0.0025	0.0289	3,250	1,107	0.76
	(0.004)	(0.003)	(0.002)***	(0.001)**	(0.004)***			

Note: ISD's represents the number of unique school districts. Obs represents total number of pooled observations. The above results were produced by a school-district fixed effects regression model using school district level panel data with probability weights that equal a district's average student population as a percent of the average annual total statewide population of students. Standard errors were clustered by school district. Dual credit (DC) and Advanced Placement (AP) represent average amounts of DC and AP credit earned per cohort per school district, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. For all models, the hypothesis that coeifficients were jointly equal to zero could be rejected with a p-value less than 0.001.

P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

Table C5.
School-District Fixed Effects Regression Results Relating Student Outcomes to Changes in Average Dual Credit (DC) and Advanced Placement (AP) Credit Earned by Course Subject

Student Outcomes	Math	English	Science	Social Science	Foreign Languages	Health	Art	Computer Science	Other	Baseline Estimate	Obs	ISD's	Rho
	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Mean/(SD)			
High School Grad Rate Year 4	**-0.034**	0.018	0.014	**0.019**	**0.085**	0.038	0.040	-0.033	-0.027	0.733	10,993	1,170	0.94
	(0.014)*	(0.009)*	(0.029)	**(0.006)****	**(0.034)***	(0.030)	(0.045)	(0.080)	(0.072)	(0.10)			
Univ App Rate Year 5	0.001	**0.040**	-0.013	**0.034**	**0.087**	0.034	0.121	0.065	-0.128	0.263	10,993	1,170	0.91
	(0.014)	**(0.008)*****	(0.033)	**(0.006)*****	**(0.032)****	(0.038)	(0.081)	(0.134)	(0.126)	(0.10)			
Univ Admit Rate Year 5	-0.003	**0.039**	-0.036	**0.038**	**0.078**	0.053	0.062	0.006	0.002	0.224	10,993	1,170	0.90
	(0.014)	**(0.008)*****	(0.034)	**(0.007)*****	**(0.027)****	(0.037)	(0.058)	(0.076)	(0.143)	(0.10)			
Univ Enroll Rate Year 5	0.012	**0.026**	0.024	**0.036**	0.055	0.024	0.041	0.006	0.026	0.202	10,993	1,170	0.90
	(0.018)	**(0.010)***	(0.043)	**(0.007)*****	(0.025)*	(0.029)	(0.033)	(0.068)	(0.085)	(0.10)			
Comm College Enroll Rate Year 5	-0.023	0.013	-0.022	-0.007	0.018	-0.017	-0.013	0.114	-0.035	0.312	10,993	1,170	0.90
	(0.014)	(0.009)	(0.031)	(0.006)	(0.022)	(0.031)	(0.035)	(0.054)*	(0.082)	(0.10)			
Associates Grad Rate Year 6	**0.008**	**0.013**	**0.033**	**0.005**	**0.034**	**0.047**	**0.094**	0.038	**0.142**	0.008	9,888	1,163	0.73
	(0.004)+	**(0.004)*****	**(0.014)***	**(0.002)***	**(0.019)+**	**(0.025)+**	**(0.023)*****	(0.047)	**(0.059)***	(0.05)			
Associates Grad Rate Year 8	0.006	**0.026**	0.016	-0.002	0.021	0.008	0.029	0.041	0.292	0.033	7,680	1,137	0.82
	(0.007)	**(0.005)*****	(0.013)	(0.003)	(0.02)	(0.014)	(0.032)	(0.040)	(0.221)	(0.04)			
Bachelor's Grad Rate Year 8	**0.020**	**0.033**	0.018	**0.022**	**0.034**	**-0.043**	-0.001	**0.053**	0.004	0.070	7,680	1,137	0.85
	(0.008)*	**(0.004)*****	(0.016)	**(0.003)*****	**(0.012)****	**(0.017)***	(0.018)	**(0.018)****	(0.095)	(0.03)			
Bachelor's Grad Rate Year 10	0.017	**0.045**	0.041	**0.026**	0.034	**-0.072**	0.014	**0.114**	0.145	0.155	5,507	1,119	0.90
	(0.013)	**(0.008)*****	(0.022)+	**(0.006)*****	(0.032)	**(0.024)****	(0.053)	**(0.057)***	(0.139)	(0.05)			
Bachelor's Grad Rate Year 12	**0.041**	**0.046**	0.056	**0.033**	0.044	-0.059	0.040	0.099	0.121	0.179	3,316	1,112	0.92
	(0.018)*	**(0.010)*****	(0.036)	**(0.007)*****	(0.037)	(0.034)+	(0.088)	(0.116)	(0.364)	(0.04)			
Graduate Degree Grad Rate Year 12	0.013	0.008	0.000	0.005	-0.007	0.016	-0.010	-0.024	-0.002	0.022	3,316	1,112	0.78
	(0.009)	(0.005)	(0.012)	(0.003)+	(0.014)	(0.019)	(0.024)	(0.030)	(0.052)	(0.02)			
Graduate Degree Grad Rate Year 13	0.012	0.000	-0.010	0.008	0.006	0.008	-0.039	-0.055	-0.109	0.028	2,222	1,102	0.83
	(0.014)	(0.007)	(0.019)	(0.004)+	(0.018)	(0.021)	(0.046)	(0.047)	(0.121)	(0.02)			

Note: ISD's represents the number of unique school districts. Obs represents total number of pooled observations. The above results were produced by a school-district fixed effects regression model using school district level panel data with probability weights that equal a distrist's average student population as a percent of the average annual total statewide population of students. Standard errors were clustered by school district. Dual credit (DC) and Advanced Placement (AP) represent the percent of students earning at least one DC and AP credit per cohort per school district, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. For all models, the hypothesis that coeifficients were jointly equal to zero could be rejected with a p-value less than 0.001. Bolded effects were statistically distinct from a majority of the other effect sizes based on a two-tailed t-test and a p-value of less than 0.05.

P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

Table C6.
School-District Fixed Effects Regression Results Relating Changes in Average Dual Credit (DC) and Advanced Placement (AP) Earned by to Student Outcomes

Student Outcomes	Master-degreed Instructor Coeff/(SE)	Doctoral-degreed Instructor Coeff/(SE)	Baseline Estimate Mean/(SD)	Obs	ISD's	Rho
High School Grad Rate Year 4	0.015 (0.010)	0.059 (0.046)	0.794 (0.08)	2,212	1,115	0.95
Univ App Rate Year 5	0.036 (0.012)**	0.053 (0.095)	0.298 (0.11)	2,212	1,115	0.95
Univ Admit Rate Year 5	0.039 (0.012)**	0.031 (0.079)	0.245 (0.10)	2,212	1,115	0.94
Univ Enroll Rate Year 5	0.047 (0.010)***	0.033 (0.052)	0.214 (0.09)	2,212	1,115	0.94
Comm College Enroll Rate Year 5	-0.005 (0.011)	0.020 (0.063)	0.316 (0.09)	2,212	1,115	0.92
Associates Grad Rate Year 6	0.017 (0.006)**	0.042 (0.035)	0.010 (0.05)	2,212	1,115	0.87

Note: ISD's represents the number of unique school districts. Obs represents total number of pooled observations. The above results were produced by a school-district fixed effects regression model using school district level panel data with probability weights that equal a distrist's average student population as a percent of the average annual total statewide population of students. Standard errors were clustered by school district. Master-degreed Instructor and Doctoral-degreed Instrutor represent the average dual credit earned in classes instructed by teachers with Master's and doctoral degrees, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. For all models, the hypothesis that coeifficients were jointly equal to zero could be rejected with a p-value less than 0.001.

P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

Table C7.
School-District Fixed Effects Regression Results Relating Changes in Average Dual Credit (DC) and Advanced Placement (AP) Earned by Instruction Mode to Student Outcomes

Student Outcomes	Face-to-face	Blended Learning	Video	Computer	Baseline Estimate	Obs	ISD's	Rho
	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Coeff/(SE)	Mean/(SD)			
High School Grad Rate Year 4	0.01	0.01	0.03	**0.23**	0.79	2,212	1,115	0.94
	(0.006)	(0.007)*	(0.011)**	**(0.060)****	(0.16)			
Univ App Rate Year 5	0.02	0.03	0.04	0.04	0.29	2,212	1,115	0.95
	(0.004)***	(0.008)***	(0.012)***	(0.092)	(0.12)			
Univ Admit Rate Year 5	0.02	0.03	0.03	0.01	0.24	2,212	1,115	0.94
	(0.004)***	(0.009)**	(0.011)**	(0.083)	(0.11)			
Univ Enroll Rate Year 5	0.02	0.03	0.04	-0.06	0.21	2,212	1,115	0.94
	(0.004)***	(0.008)***	(0.011)***	(0.114)	(0.11)			
Comm College Enroll Rate Year 5	-0.01	0.01	0.01	0.10	0.32	2,212	1,115	0.92
	(0.006)	(0.008)	(0.014)	(0.086)	(0.15)			
Associates Grad Rate Year 6	0.01	-0.01	0.01	0.00	0.01	2,212	1,115	0.87
	(0.002)***	(0.003)*	(0.005)	(0.016)	(0.06)			

Note: ISD's represents the number of unique school districts. Obs represents total number of pooled observations. The above results were produced by a school-district fixed effects regression model using school district level panel data with probability weights that equal a distrist's average student population as a percent of the average annual total statewide population of students. Standard errors were clustered by school district. Master-degreed Instructor and Doctoral-degreed Instrutor represent the average dual credit earned in classes instructed by teachers with Master's and doctoral degrees, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. For all models, the hypothesis that coeifficients were jointly equal to zero could be rejected with a p-value less than 0.001. Bolded effects were statistically distinct from a majority of the other effect sizes based on a two-tailed t-test and a p-value of less than 0.05.

P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

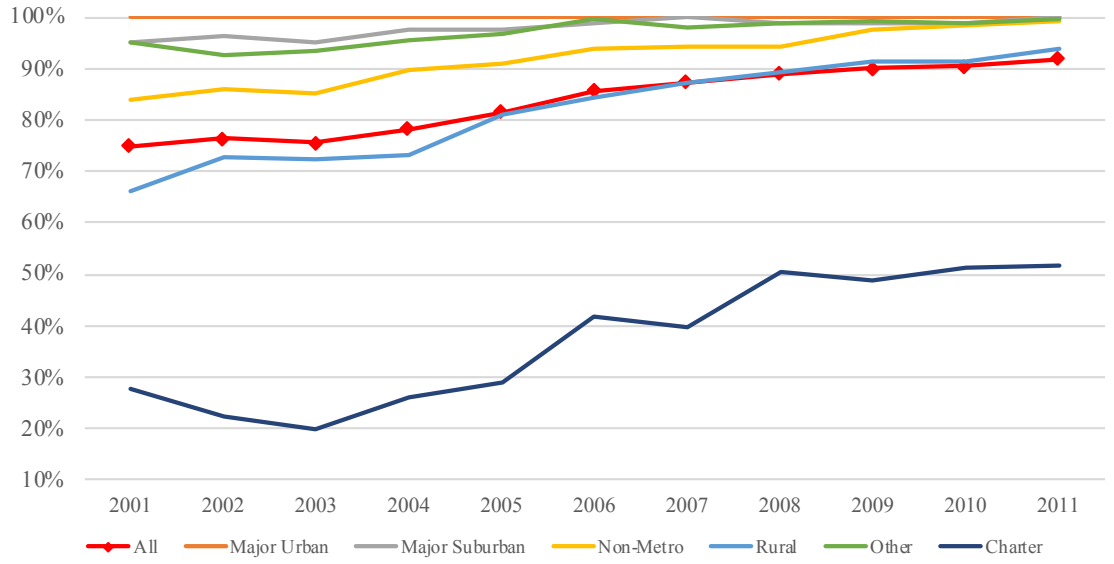
Table C8.
School-District Fixed Effects Regression Results Relating Changes in Average Dual Credit (DC) and Advanced Placement (AP) Earned by Instruction Location to Student Outcomes

Student Outcomes	University Campus Coeff/(SE)	Community College Campus Coeff/(SE)	High School Campus Coeff/(SE)	Other Sites Coeff/(SE)	Baseline Estimate Mean/(SD)	Obs	ISD's	Rho
High School Grad Rate Year 4	0.038 (0.020)+	0.007 (0.004)	0.000 (0.007)	0.006 (0.006)	0.79 (0.10)	2,068	1,060	0.90
Univ App Rate Year 5	-0.003 (0.014)	0.011 (0.003)**	0.017 (0.004)***	0.020 (0.005)***	0.30 (0.09)	2,068	1,060	0.95
Univ Admit Rate Year 5	-0.011 (0.012)	0.008 (0.003)**	0.014 (0.004)***	0.020 (0.005)***	0.25 (0.08)	2,068	1,060	0.94
Univ Enroll Rate Year 5	0.014 (0.012)	0.013 (0.003)***	0.015 (0.004)***	0.023 (0.005)***	0.21 (0.08)	2,068	1,060	0.93
Comm College Enroll Rate Year 5	0.031 (0.022)	-0.009 (0.004)*	-0.004 (0.005)	0.001 (0.006)	0.32 (0.11)	2,068	1,060	0.91
Associates Grad Rate Year 6	0.008 (0.004)+	0.010 (0.002)***	**-0.004 (0.002)***	0.002 (0.002)	0.01 (0.04)	2,068	1,060	0.89

Note: ISD's represents the number of unique school districts. Obs represents total number of pooled observations. The above results were produced by a school-district fixed effects regression model using school district level panel data with probability weights that equal a distrist's average student population as a percent of the average annual total statewide population of students. Standard errors were clustered by school district. The four dual credit locations represent the average dual credit earned in dual credit classes located at a university, community college, high school, and other sites, respectively. Baseline estimates represent the average of expected outcomes when participation n dual credit is zero. Bolded effects were statistically distinct from a majority of the other effect sizes based on a two-tailed t-test and a p-value of less than 0.05.

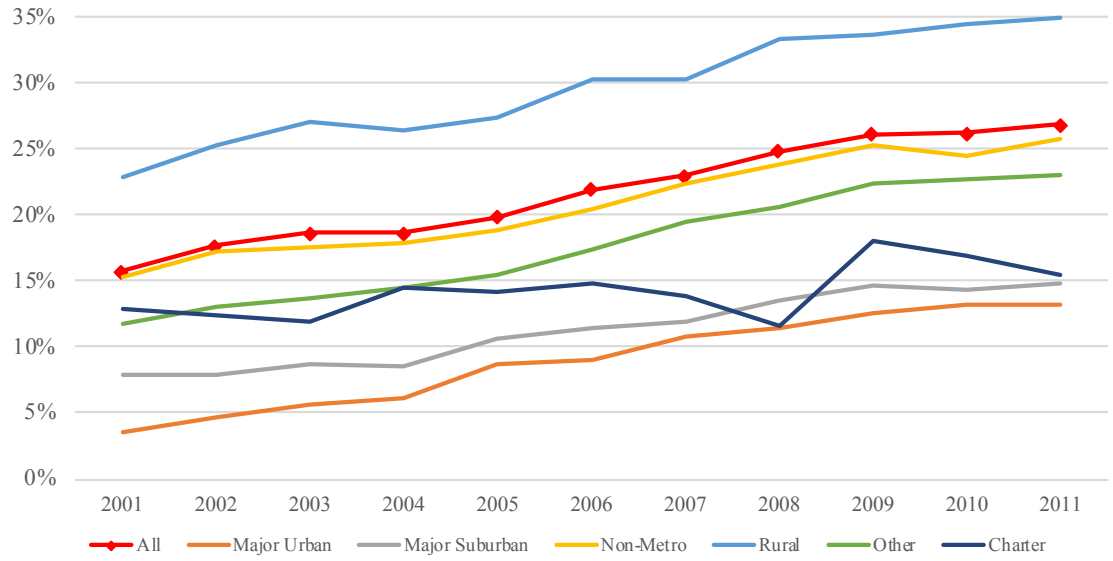
P-value thresholds were represented at the following levels: < .0001 ***, <.001 **, <.05*, <.1+.

Figure C1. Adoption of Dual-Credit Policy by Type of School District



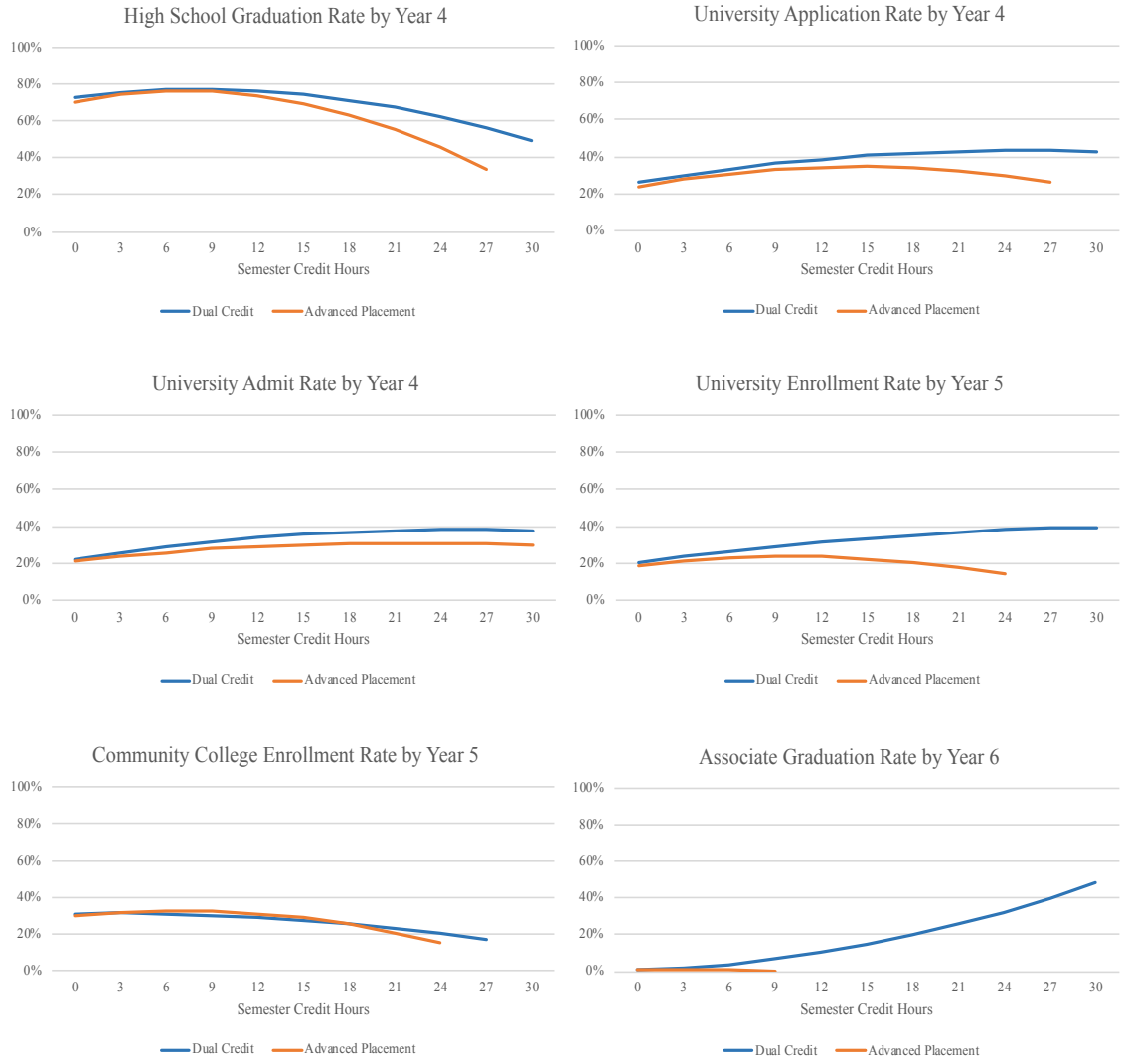
Note: Categories of school districts are defined by the Texas Education Agency. The horizontal axis represents the 9th-grade-entering year of each cohort analyzed.

Figure C2. Student Participation in Dual Credit at Dual-Credit School Districts by Type of School District



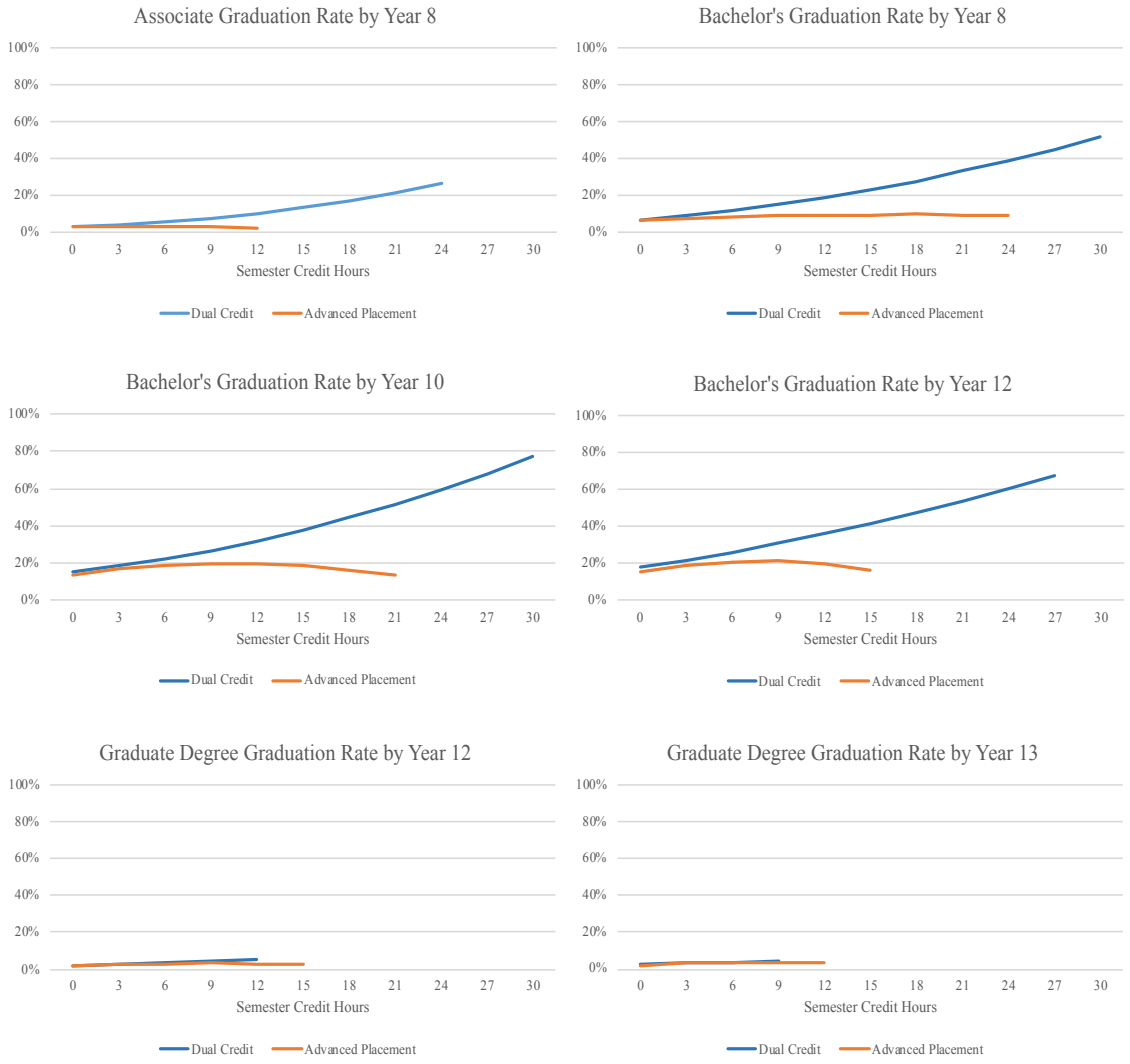
Note: Categories of school districts are defined by the Texas Education Agency. The horizontal axis represents the 9th-grade-entering year of each cohort analyzed.

Figure C3. Change in Student Outcomes by Increasing Levels of Average Credit Earned in Dual Credit, CTE Dual Credit, and AP (measured in semester credit hours)



Note: Estimates are derived from a school district fixed effects regression model using school-district level panel data. Relationships are graphed if they are statistically significant based on a two-sided t-test with a p-value of less than 0.05.

Figure C3 Continued. Change in Student Outcomes by Increasing Levels of Average Credit Earned in Dual Credit, CTE Dual Credit, and AP (measured in semester credit hours)



Note: Estimates are derived from a school district fixed effects regression model using school-district level panel data. Relationships are graphed if they are statistically significant based on a two-sided t-test with a p-value of less than 0.05.

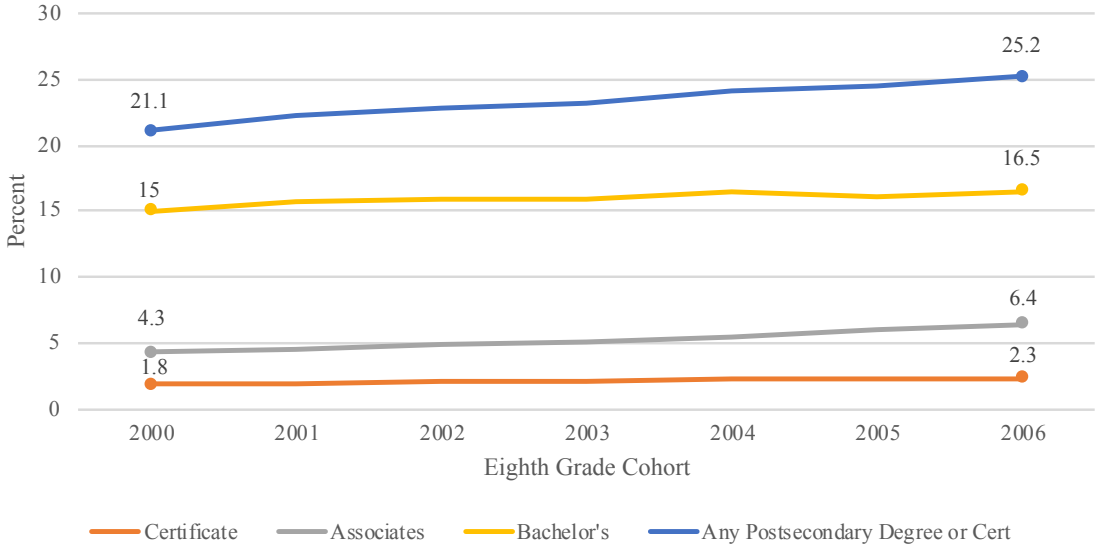
Appendix D

Table D1. Back-of-the-envelope Calculation of Net Economic Impact of TEXAS Grants

	$	124,313	Net benefit to taxpayers of helping one student complete bachelor's degree
x		5%	Additional years of work
x		17,096	Awardees
	$	106,262,552	Benefit to taxpayers for shortened time to degree
		17,096	Awardees
x		4%	Effect on Bachelor's degree completion
		684	Students who earned a bachelor's degree due to receiving a TEXAS grant
x	$	124,313	Net benefit to taxpayers of helping one student complete bachelor's degree
	$	85,010,041	Benefit to taxpayers for increased educational attainment rate
		17,096	Initial TEXAS grant awards
+		20,720	Renewd TEXAS grant awards
		37,816	Total awards
x	$	(6,938)	Average TEXAS grant cost per award
	$	(262,369,850)	Cost of TEXAS grants
	$	5,512	Average decline in student debt
x		17,096	Awardees
	$	94,233,152	Benefit to students of reduced student debt
	$	865,183	Marginal increase in lifetime earnings of helping one college student complete bachelor's degree
x		5%	Additional years of work
	$	43,259	Increase in earnings from shortening time to bachelor's degree
x		17,096	Awardees
	$	739,558,428	Benefit of shortening time to bachelor's degree
		17,096	Awardees
x		4%	Effect on Bachelor's degree completion
		684	Students who earned a bachelor's degree due to receiving a TEXAS grant
	$	865,183	Marginal increase in lifetime earnings of helping one college student complete bachelor's degree
	$	591,646,743	Benefit for increased educational attainment rate
	$	576,789	Marginal increase in lifetime earnings from helping one college graduate earn a graduate degree
x		5%	TEXAS grant effect on graduate degree completion
x		17,096	Awardees
x	$	593,885	Benefit from increased graduate degree holders
	$	**1,354,934,951**	**Net Economic Benefit**

Note: This calculation assumes the marginal increase in lifetime earnings of helping an average college student complete a bachelor's degree is $865,183, the marginal increase in lifetime earnings of moving an average student from bachelor's degree-only to earning a graduate degree is $576,789, the net impact to taxpayers of helping an average college student earn a bachelor's degree is $124,313, the TEXAS grant effect on bachelor's degree completion rates is 4 percent, the TEXAS grant effect on time to bachelor's degree is a decrease of two years, the TEXAS grant effect on student debt is $5,512, the TEXAS grant effect on graduate degree completion is 5 percent, and the average cost of a TEXAS grant award for one year is $6,938. All figures are in 2016 current dollars.

Figure D1.
Texas Completion Rates Six Years after High School Graduation
by Eighth-Grade Cohort, FY 2000-2006



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